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MAY, 1959

ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

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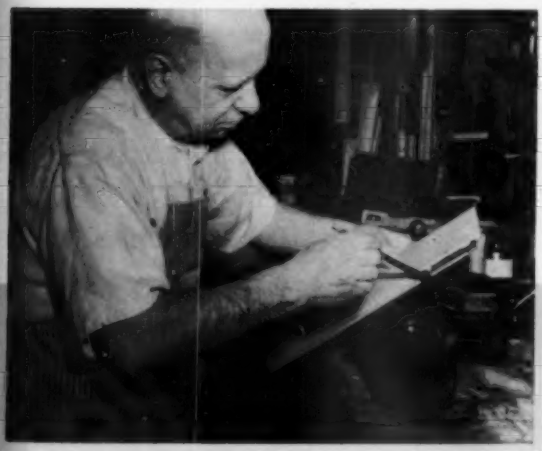
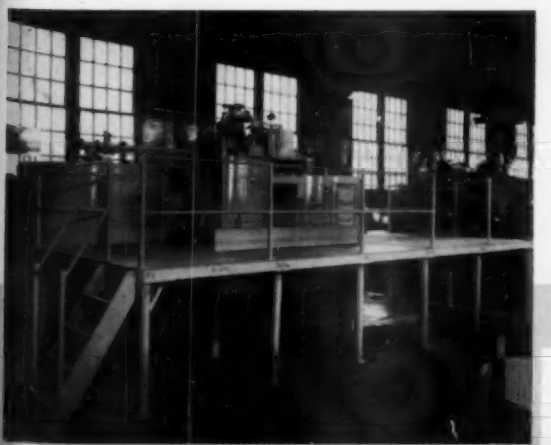
In-Plant Handling of Bulk Materials

PNEUMATICS AND ADHESIVES 28



Techniques for Custom Cabinet Work

BONDING WOOD VENEERS 20



Corrugated Board Production

MIXING STARCH ADHESIVES 24

THREAD-THIN contact is all that's required to bond the open end of the thimble. The adhesive used here holds fast at over 5000 psi in overlap shear (aluminum-aluminum); makes load-bearing honeycomb sandwich structures practical.

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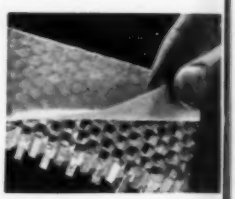

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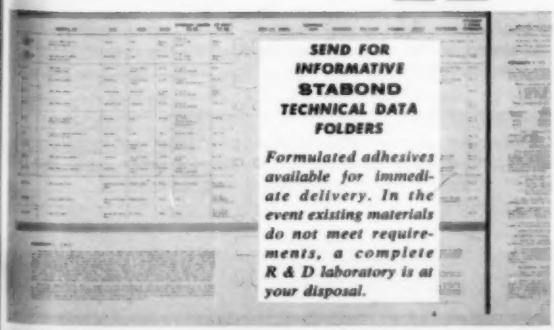

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ADHESIVES AGE

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About the Cover Photographs

Some of the aspects of adhesives manufacture and application covered in this issue are shown. Pneumatic equipment for handling adhesive bases is shown in the top photo, used by courtesy of Sprout, Waldron & Co., Inc. The center photo of glue being applied to the tenon edge of a wood panel is from a staff series on bonding custom furniture. A 666-gallon paste mixing unit for corrugated board manufacture is shown in the bottom photo supplied by Corrugated Adhesive and Combiner Consultants, Inc.

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PALMERTON PUBLISHING CO., INC.

MAY, 1959

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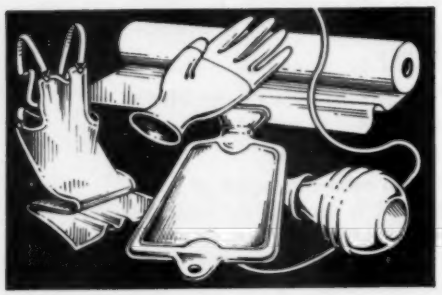

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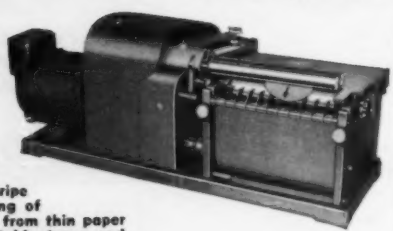

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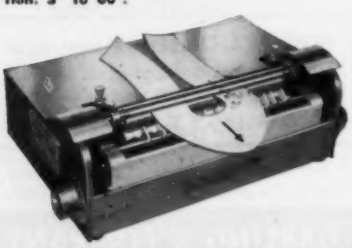

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EDITORIAL

Looking Ahead

Now that ADHESIVES AGE has been in existence for more than six months, we are permitting ourselves the luxury of some observations about this industry of ours. One of the major points which comes to attention is the amazing vitality of the adhesives industry. In scanning news reports as they appeared in our journal we have been struck by the degree of activity now going on—activity denoting growth, expansion, optimism. Witness these facts:

- H. B. Fuller Co. has announced plans for a new adhesives manufacturing plant at Fairfax, Kansas.
- National Adhesives (Canada) has begun construction of a vinyl emulsion plant in Toronto.
- Borden Chemical is constructing a new adhesives and coatings facility at Illiopolis, Ill.
- Armour plans the construction of a new dried blood plant at St. Paul, Minn., for the production of a new, water-resistant adhesive.
- Reichhold Chemicals has completed a polyvinyl acetate emulsion plant at Kansas City, Kansas.
- National Starch plans a 50 per cent expansion of its vinyl acetate polymerization plant at Meredosia, Ill.
- Union Carbide will build a new plant for the production of liquid epoxy resins at Marietta, Ohio.
- Pacific Glue Manufacturing is building a second adhesives plant at Seattle, Wash.
- Pennsylvania Lacquer is expanding its facilities for the manufacture of epoxies.
- Morningstar-Paisley has begun production of liquid vinyl chloride and natural and synthetic latex compounds at its new plant in Clifton, N.J.
- J-G Chemists are opening a new adhesives plant at Murray, Ky., this spring.
- American Viscose and Sun Oil have established an equally owned affiliate for the manufacture, amongst other things, of adhesives.
- Goodrich has opened its new $2.5 million adhesives plant in Akron, Ohio.

Surely, these facts are evidence of a new and rapid growth rate for the adhesives industry. Adhesives manufacturers are apparently expecting more business, reflecting increased activity on the part of the adhesives consumer. Suppliers to the adhesives industry are also accelerating production to meet demands from new adhesives plants.

Where do *you* stand in this new approach picture? Are you making provision for the future? The industry is on the move—are you prepared to move with it?

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CONSULTANT'S CORNER

By Dr. Irving Skeist

Question: My problem is to get the best, permanent adhesives for pasting leather and imitation leather on gold plated brass.

Answer: A rubber is called for here. While many rubbers might work, *neoprene* is favored for this type of application. The neoprene, in either latex or solvent cement, is applied to both surfaces, the water or solvents are evaporated, and the tacky surfaces are brought together. A *urethane* adhesive might also be applicable. The urethanes have the advantage of 100 per cent solids content, but the disadvantage of requiring the mixing of two components just prior to use.

Question: In the manufacture of shoe uppers, we bond leather to itself by coating both surfaces with cement, letting some of the solvent evaporate before we put the pieces together. It would help us tremendously to be able to coat only one of the surfaces.

Answer: Pyroxylin dopes have been the traditional adhesives for leather. They give excellent bonds, but must be applied at low viscosity for adequate wetting, and composited at higher viscosity for adequate tack. This means coating both surfaces.

An *epoxy* adhesive may work satisfactorily when applied to only one side. One of the higher viscosity liquid epoxy resins should be used, together with an aliphatic amine or modified aliphatic amine catalyst to provide cure at room temperature. These are two part systems. After mixing, they have pot lives of an hour, more-or-less. Machines are available to dispense the two components in the right proportion, or to meter, mix and dispense them. Coat the smoother surface, if there is a difference between the two. After bonding, let the composite stand for several hours before applying any stress to it. The bond will set faster if heated.

Question: We are concerned with the problem of bonding neoprene gaskets to metal surfaces. Once the gaskets are fixed in place, they are subject to lateral forces of about 100 lbs. per square inch. We should like very much to find an adhesive compound including a method of bonding the neoprene gasket to either stainless steel or cast iron. The gaskets enclose an area of approximately one square foot. They are square in shape and have a surface area available for bonding of approximately 1" wide on all four sides. We would like to accomplish this without vulcanizing if possible. Any suggestions you might be able to offer us along these lines would be greatly appreciated.

CONSULTANT'S CORNER

Answer: A neoprene solvent cement should give adequate performance. The cement should be compounded with minimum resin loading, so as to achieve highest shear strength. (Resins improve tensile strength, but reduce elongation. Shear strength requires both; it is related to the area under the stress-strain curve, which is greatest at rather low resin/neoprene ratios.

Neoprene cements may be compounded to be—in order of increasing strength—non-curing (no vulcanizing agent), air-curing (very fast vulcanizing agents), or heat-curing (moderately fast vulcanizing agents). You apparently require an air-curing composition.

Question: Will appreciate your sending us information regarding adhesives that may be used for fusing two pieces of cloth together to make knee patches.

Answer: A patching tape can be made by coating cloth with a vinyl plastisol or organosol. Plastisols are suspensions of vinyl chloride resins in plasticizers (non-volatile softeners), while organosols contain these ingredients plus volatile solvents and diluents. Both are thick pastes at room temperature. Heavily plasticized compositions have the best tack. A patented composition avoids blocking of the coated cloth in roll form through the use of solid plasticizers instead of the common liquid ones. In addition, the vinyl resin is "internally plasticized" by copolymerizing vinyl chloride with another monomer.

The plastisol or organosol is applied to the cloth in heavy weights, of the order of four to five dry ounces per square yard, to insure that adequate adhesive will be available for bonding with the garment being patched. Then the web is heated, first to drive off volatiles if an organosol is employed, and finally to fuse the coating by dissolving the finely divided particles of resin in plasticizers. After cooling and slitting, the tape is ready for patching with the aid of a hot iron.

Question: We have developed for our own use a thermoplastic adhesive that we find has a shear strength of about 2400 lbs. per square inch on steel and a tensile strength of 1000 lbs. per square inch. It is necessary to heat parts to about 280-300° F. before applying the stick. It bonds about everything we have tried and seems to have quite a bit of chemical resistance.

Could you inform us how the shear strength of our material compares with other thermoplastic adhesives and whether or not this material would prove useful in industry and if so where the best fields might be.

Answer: The adhesive appears to be limited in scope. Shear strength is moderate but tensile strength is low. It may be impractical to heat before bonding, especially if the adherends are large. Thermoplastic bonds can fail in articles exposed to heat, and are generally considered inadvisable in structural applications.

On the other hand, the chemical resistance is desirable—so is the stick form. Perhaps this adhesive can be applied most conveniently with the aid of a soldering iron.

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

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Concrete Bondant

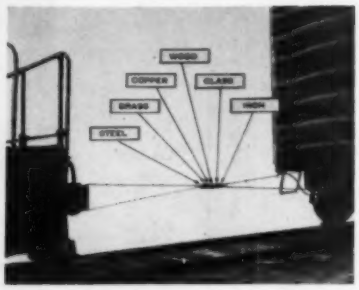
Particularly applicable for bonding new concrete to old concrete, Adhesive 348 may also be used to bond steel, brass, aluminum, glass-fiber polyester and epoxy, polyvinyl chloride, and wood to each other and to new concrete. The high tensile strength of the bond formed prevents moisture from seeping in around joints to cause spalling, flaking, and gradual disintegration of the mended area. From 30 to 60 minutes after the adhesive has been applied, the new concrete can be poured. The modified epoxy bondant is prepared immediately before use by mixing two components. Application of the mixture is by brush. Adhesive 348 cures at normal temperatures. *Ceilcote Co.* **P-101**

Binding Agent

Said to be a unique binding agent for metal, glass, many plastics, cloth, wood and rubber, Number 2383 Adhesive is used in factories for operations such as attaching vinyl plastics or rubber to furniture or equipment. It is also used in the production of paint rollers to attach plastic foam to impregnated cardboard. The dry film is resistant to aliphatic hydrocarbons, water and petroleum oils. *Dennis Chemical Co.* **P-102**

Epoxy Bondants

Besides bonding similar and dissimilar materials, the Cepox 400 adhesives can be used for sealing and filling gaps. They were developed for cementing cast iron, steel, copper, aluminum, bronze, brass, plastics and other surfaces to themselves and to each other. Thermosetting, the adhesives produce tough,



water-insoluble bonds that resist most acids, alkalies and other chemicals. They have high impact, tensile shear, and compressive strength and will not dry out, crack, or deteriorate with age. Because they are made of 100 per cent solids with no solvent or diluent present, they will not shrink. Cepox 401 produces a tough, rigid bond and requires no heat or pressure curing. Cepox 402 produces a strong, flexible bond with high peel strength. It cures at room temperature. *Chemical Development Corp.* **P-103**

Plastic Cement

Because it dries crystal clear, Ambroid Plastic Cement eliminates objectionable seams at adhesion points. It is designed to fill the need of hobbyists and craftsmen for a quick-drying cement that forms a strong bond on the styrene plastics used in making models and toys. Spillage can be cleaned up with minimum surface damage. *Ambroid Co.* **P-104**

Liquid Monomer

N-Vinyl-2-pyrrolidone is a liquid monomer which forms copolymers and water-soluble polymers that have film-forming properties and strong adhesive characteristics. The end-products will adhere to wood, paper, glass, human skin, hair, nylon, and urethane foam. They form films which are smooth, continuous, and hard. The hydrophilic character of a copolymer is dependent on the vinylpyrrolidone content. Depending on the comonomer and the percentage of vinylpyrrolidone used, adhesives may be developed which are tenacious and durable, oil-and grease-resistent, pressure-sensitive, or temporary and water-removable. Copolymers of vinylpyrrolidone and maleates produce permanently tacky, pressure-sensitive materials. Copolymers of the liquid monomer and isobutyl vinyl ether are exceptionally adhesive to glass. *Dyestuff & Chemical Division, General Aniline & Film Corp.* **P-105**

Mending Tape

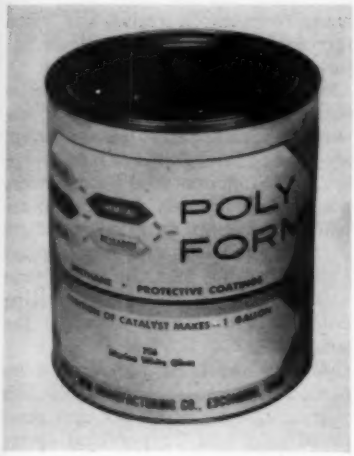
The delayed setting action of Dulseal facilitates accurate positioning of this transparent adhesive mending tape. With its protective wax coating removed, the film on Dulseal becomes just tacky enough to allow approximate positioning. Several hours later it can still be relocated if necessary. Left untouched for about 24 hours, the film's adhesive sets and forms a permanent bond with the paper or cloth to which it was applied. According to the manufacturer, the .0015-inch thick acetate makes a durable protective coating for documents that get a lot of handling. Washable, waterproof and chemically stable, it can also be used for covering outdoor notices. The tape's matte outer surface will take pen and pencil. *Keuffel & Esser Co.* **P-106**

Modified Hot-Melt

Delivered in the form of dust free pellets, Glu-Beeds are a modified hot-melt adhesive. For bonding porous materials at high speeds, they are melted in water at about 140°F. and held at a temperature of about 130°F. while the mixture is spread or applied as thinly as possible. Applied films stay on the surface and because there is no undue penetration, porous materials bonded do not warp. Materials should be joined during the period of high initial tackiness while some slight warmth still remains. There is no practical limit to assembly speed, states the manufacturer. Dried glue films have a tensile strength of 4000 psi. A high degree of permanent flexibility may be obtained by adding glycerine to the solution. *Burtonite Co.* **P-107**

Urethane Coating

Poly-Form, a non-toxic urethane protective coating, is said to last from four to six times longer than conventional coatings and to cover from two to three times more area per gallon. Formulated to be very



rigid or flexible, and containing a very high percentage of solids, it is nevertheless easy to apply by brush, spray, roll, or dip on wood, concrete, metal, fibreglass, fabrics, etc. Custom formulated supplies available in quart or gallon sizes. The special thinner required is also available in quarts or gallons. *Poly-Form Mfg. Co.* **P-108**

Packaging Tape

The two-mil, smooth backing of Permacel 331, a pressure-sensitive packaging tape made of Saran, is coated with a specially formulated translucent adhesive which is said to have excellent low temperature properties. Because the Saran backing will remain flexible at low temperatures, the tape is ideal for packaging frozen foods. Permacel 331 is printable and has excellent resistance to oil, water, gasoline, and chemicals. The tough Saran film has good flex and scuff resistant qualities as well as high dielectric strength. *Permacel.* **P-109**

Seal Glue

The economy and glossy film qualities of a dextrine glue and the noncurl and machining speed advantages of a resin are said to be combined in Layflat, a new fast-drying front seal adhesive. Little or no drying heat is required and the product runs cleanly at extreme production speeds. It is particularly recommended for use on white wove or kraft paper stocks. Because Layflat does not contain volatile organic solvents it is nonflammable, nontoxic and will maintain its stability under varying production or climatic conditions. Neither special glue pots nor seasonal changes in adhesive or machine equipment are necessary. Layflat is available in two film colors: 16-6270 (very light in color) and 16-6272 (slightly darker). *National Starch Products Inc.* **P-110**

Flocking Adhesive

Nonflammable and waterproof, Resgrip WP Flocking Adhesive is said to be excellent for making pennants, insignia, signs and for applying flock in the manufacture of decorative fabrics. It can be applied by machine or silk screen. The adhesive dries transparent and is non-

staining. When dry it is extremely flexible and produces a product free of the usual harsh feel characteristic of adhesives, states the manufacturer. The product is quick-drying and items made with it can be washed in boiling water or dry-cleaned. *Adhesive Products Corp.* **P-111**

Clean-Up Material

Utensils, spatulas, syringes, table tops and work pieces themselves can be quickly freed from superflous epoxy and polyester resins with Monastrip EP. Tools may be washed by use of a brush or swab to remove accumulation. The product may also be forced through syringes or pressure guns. Component and circuit manufacturers have found that this material speeds up their potting operation in a rapid and effective cleaning operation, states the manufacturer. *Mona Industries, Inc.* **P-112**

FOR MORE INFORMATION on the new adhesives described in these columns, use the Reader's Service Card elsewhere in this issue.

Elastomer-Resin Cements

Although thermoplastic, XL-8 and S-18 have fine resistance to temperature changes met with even under tropical conditions, the manufacturer points out. Because of their ability to bond rigid surfaces,

most building materials, some tile and plastic items, and porous or pliable surfaces, they are said to have found wide use in industry as general purpose adhesives. Features such as fast drying, quick setting and ease of application make them ideally suited for fast assembly operations. The cements require no cure or hardening agents. If stored in a cool place they have a guaranteed one-year shelf life. Use for vinyls, Mylar and some plastics affected by the solvents employed is not recommended. *R-H Products Co.* **P-113**

Roof Cement

Features of Handi-Gard plastic asbestos roof cement include quick-sealing adhesion and easy application on damp days. The product can be used for repairing roofs even during cold weather. It is smooth spreading even at low temperatures and adheres to metal, composition and brick. Reinforced with long Canadian Asbestos Fibre, it has a long wearing asphalt base. *Gibson-Homans Co.* **P-114**

Adhesive Coating

Designed for use on box toe and suedine quarter lining materials employed in the shoe industry, Kling Coat makes it possible to assemble the entire shoe without using latex or rubber cements. The adhesive coating can be activated by either water or steam. It is said to be extremely compatible with all types of leathers and is guaranteed to eliminate piping, wrinkling and bubbling. *Pres-Stick, Inc.* **P-115**

letters to the editor

Dear Sir:

May we be allowed to comment briefly upon the most interesting article "Space Age Adhesives," contributed by Mr. F. H. Bair of Wright Air Development Center to your February issue?

First, to the best of our knowledge, the introduction of "Redux" adhesive preceded that of Cycleweld and, in any case, "Redux" was certainly in the field some years before the other adhesives mentioned in the article.

Secondly, we believe that to complete the general picture full credit should be given to the de Havilland Aircraft Company who, in 1942, made use of "Redux" for bonding wood to metal in the Hornet fighter aircraft and soon afterwards began work upon the design of the Dove. Some 22,500 "Redux"-bonded components have been made for the 500 odd Dove aircraft manufactured since June 1946 and these parts included examples of important structural applications such as attachments of stringers to skins.

The de Havilland Company continues to use even larger quantities of "Redux" in its most recent designs. As far as we know, such extensive use of bonding techniques has not hitherto been adopted in U.S.A., with the important exception of the Fairchild Aircraft Corporation who are bonding the Friendship under license and using "Redux" for this purpose.

K. S. MEAKIN
Ciba (A.R.L.) Ltd.,
Duxford, Cambridge,
England

Paper Box Meeting

The 100 best cartons of 1958 were chosen by the Folding Paper Box Association of America at its Annual Meeting on March 23-25, at the Drake Hotel in Chicago, Ill. Forty-nine boxmakers were represented among the winners, which were selected by four panels of printing and packaging experts. Cartons were judged in four major categories: technical superiority of printing; superiority of construction; best example of potential new volume use; and general merchandising superiority. During April and May the 100 award winners will be shown in 20 major cities under the sponsorship of advertising and sales executives clubs.

Adhesive Tape Process

Behr-Manning Co., Watervliet, N.Y., has announced the development of a new process for making an easy-to-unroll adhesive tape. The company reports that the new manufacturing process permits pressure-sensitive tape to be unwound more readily without reducing its adhesion to surfaces.

RCI Building Plant

Pacific Northwest Division of Reichhold Chemicals, Inc., has begun construction on a new plant at Tacoma, Wash., for the manufacture of resins for the forest products industry. According to the company, the plant should be completed and in operation during the summer, and will cost approximately $250,000. RCI is presently making dry adhesives as well as formaldehyde and pentachlorophenol at its Tacoma facility. The division plans to centralize its adhesive and chemical manufacturing plants and office in Tacoma. The company has announced that Harold O. Warner, plant manager at Seattle, and R. B. Walker, production manager at Seattle, will also supervise the new Tacoma resin plant.

Earnings Up in 1958

Morningstar-Paisley, Inc., New York, N.Y., reports that its earnings after taxes for 1958 amounted to $550,524, or $1.11 per share, compared with $483,277, or 98¢ per share, for 1957. Sales increased from $21,813,478 in 1957 to $23,136,122 for 1958.

Epoxies Discussed

A recent article in *Highway Research Abstracts* reports that a chemical research has introduced a variety of new glues which have an almost bewildering array of capabilities. Many of the new adhesives, made from epoxy resins, are often referred to as epoxies. Plastic in nature, they link the molecules of the adhesive with those of the material being bonded. The item noted that when cracks appeared in a concrete abutment of the Golden Gate Bridge in San Francisco, Calif., engineers used an epoxy resin adhesive to repair them. Prefabricated concrete roadside curbs are now being glued into place, thus eliminating the time and expense involved in pouring concrete and making forms at the road site.

One of the most curious new tenacious bonding agents is a blackish putty consisting of 80 per cent powdered steel and 20 per cent epoxy resin. A catalyzing chemical quickly reacts with the resin to form a stubborn bond which not only joins materials together but also joins together the steel particles of the putty which, in effect, become solid steel and are capable of being machined like the metal itself. Patching holes in radiators or filling holes in castings are just a few uses for these materials. With new uses being found for these glues, many of tomorrow's structures may be glued together rather than nailed.

Margolis Gives Talk

James Margolis, president of Chemical Marketing & Research Co., New York, N.Y., gave a talk on "Outlook for Synthetic Adhesives" at the March 20 meeting of the Metropolitan Long Island Subsections of the American Chemical Society. Mr. Margolis estimated that synthetic adhesives—phenols, urea and melamine, and vinyls—would climb, in 1959, 15 per cent higher than last year's level. Mr. Margolis based his prediction on the premise that phenolics are expected to lead the advance in synthetic adhesives. He mentioned that building construction materials, such as honeycomb sandwich panels for office and public building curtain walls as well as aircraft, were some of the adhesive consuming products that should contribute to this year's gain. Epoxies, not a large volume factor now in total synthetic adhesive sales, was singled out for its attractive long-term prospects.

capitol cues

NO REAL BOOM IS LIKELY TO DEVELOP THIS YEAR—that's the prevailing view of government officials and economists. This does not mean that they expect the recovery to die down. On the contrary, they believe that there will be further rises, but the pace will be slow and moderate from today's already record high levels. A big boom in business isn't likely until 1960.

The basic ingredients of a real boom are just not present now.
- Government spending, for example, is rising at a slowing pace. So scratch this very powerful force for business expansion.
- Capital spending for new plant and equipment will go up only 4% this year, according to government estimates. In the last two postwar recoveries, the rise averaged something like 25%.
- Consumer outlays for durables are going well, but auto sales won't hit 6 million, as against 7 million in the past upturns.

BUSINESS WILL SEE ITS BEST PERIOD OF '59 THIS SPRING as a result of several special factors working together. One of them, of course, is the seasonal pick-ups in agriculture, construction, etc., that always come with warm weather. Another is the heavy hedge-buying of steel and other metals in anticipation of strikes and price rises. Finally, there's the fact that the rise in outlays for new plant and equipment is centering in this quarter.

Some economists believe that business may look too good this Spring. They fear that part of its bounce will come at the expense of the future. Things may slow this Summer—even if there's no steel strike—when metal orders return to normal.

UNEMPLOYMENT IS GOING TO REMAIN HIGH and continue as one of the most pressing of our economic problems until a new boom develops. There are now more than 4.5 million out of work even with business activity above the peak of the pre-recession period. There are few signs that the number will drop. The U.S. may have to live with twice as much unemployment as it's used to.

Two factors are operating to keep unemployment high:
- Productivity—output per manhour—has been increasing more rapidly this year; this gives increased output with a very few extra workers. So, the job market is not being helped.
- The workweek is being lengthened to handle increased orders, reducing the need to put laid-off workers back on payrolls.

CORPORATE PROFITS THIS YEAR WILL BE HIGHER—by $1 to $2 billion dollars—than even the most optimistic forecasters have been expecting up to now. The Treasury Department originally anticipated $47 billion, which would be $11 billion over 1958 and $1.5 billion higher than the 1956 record. Present estimates are now going as high as $52 billion. Those who talk of $50 billion are classed as conservatives. Higher earnings by corporations will begin to make the current level of stock market prices look reasonable.

capitol cues (cont'd)

SOME CUTS IN TRANSPORTATION COSTS ARE COMING this year. Railroads in the eastern part of the U.S. are actively trimming their rates to become more competitive with the long-awaited St. Lawrence Seaway, just completed. The Seaway is adopting low tolls in an effort to lure some traffic from overland facilities. Shippers may be able to save on cargoes for the East Coast, Europe, and Latin American destinations. Competition for traffic is also likely to bring some rate reductions by trucking lines and barge owners.

On the passenger side, there is likely to be some increase in rates. The airlines are considering some boosts on charges for jet tickets. This will probably affect overseas trips only.

ANOTHER BUMPER CROP YEAR IS IN PROSPECT for 1959, according to the estimates of the Agriculture Department. The government experts see good growing conditions, more acres in cultivation, and larger livestock herds. Farmers will plant 2% more acres this year, with most of the increase coming from the 17 million acres just released from the Soil Bank program.

Here's a rundown on the outlook for some of the major crops.

- Livestock: Meat production will go up about 8%; most of the hike will come in pork. Some cuts in prices are expected.
- Wheat: This year's harvest may dip 20% or so, to around 1.2 billion bushels—still more than the market can consume.
- Soybeans: Lower price supports and competition from corn will probably bring a drop in harvestings of around 7 to 9%.
- Poultry: Broiler, egg, and turkey crops will show rises.
- Vegetables: Corn, tomatoes, and beans are likely to be in good supply; onions, lettuce, and carrots will decline.
- Fruits: Pickings of oranges and grapefruit will be greater.

BUSINESS IN CANADA IS RECOVERING MORE SLOWLY than in this country. Normally, the cycle for our Northern neighbor follows ours pretty closely. Its economy is tied to ours because we're its biggest customer—by far. But this cycle is different because we're taking less oil, metals and farm products this year—and these are the mainstays of the Canadian economy.

- Industrial production in Canada has risen only 3% to 4% since the recession's low, as compared with 13% to 14% in the U.S.
- Nonfarm employment is up 2%, about the same as in this country.
- Total output of goods and services—Gross National Product has regained 3% of the loss and is now 2% over the old peak.

Despite the slow rate of rise, the economy of Canada will probably reach new record highs during the rest of this year.

PROSPECTS FOR A NATIONAL FAIR TRADE BILL are dimming. The measure, which would let maufacturers set their own retail prices, probably will be reported favorably by the House Commerce Committee and may pass the House at this session. But, it has not aroused much support in the Senate. The bill drew only two sponsors when it was introduced in the upper house. So, backers of the legislation may delay their Senate drive until next year.

Even if the measure does clear both the House and Senate, it may well run into a veto by the President. Ike's advisers see it as a breach of antitrust laws. His veto would stick.

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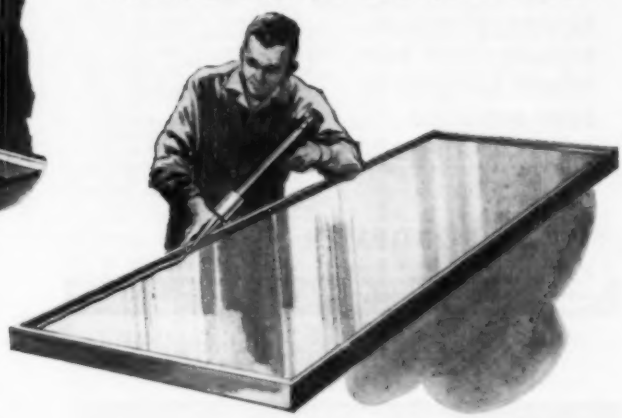

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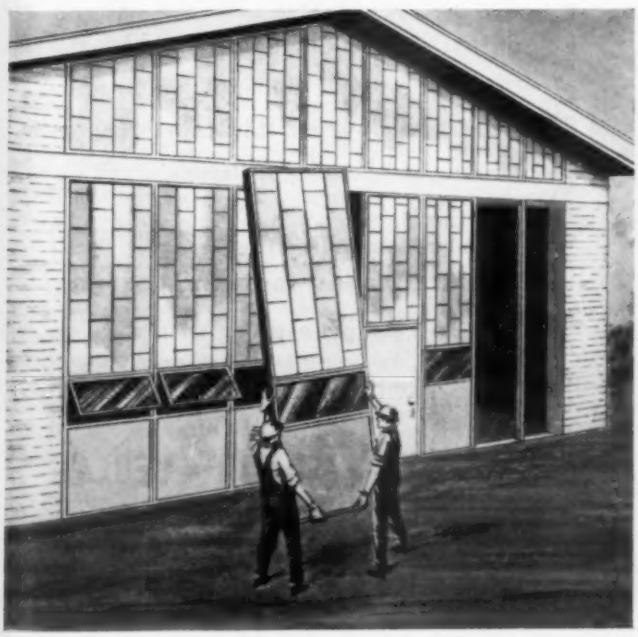

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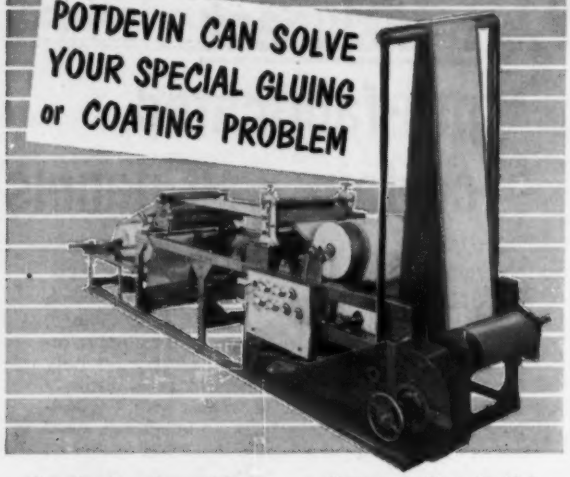

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• Two French companies, Péchiney and the Société Normandie de Matières Plastiques will produce "Moplen" in France under license from the Montecatini Company (Italy). Production of the polypropylene derivative is expected to rise to 10,000 tons per annum in the first stage.

• The Dutch firm, AKU of Arnhem, and the State Mines of Limburg, have opened a combined plastic sales office, Verenigd Plastic Verkoopskantoor at Zeist, near Utrecht. The combined office is expected to increase the efficiency of marketing operations in relation to the European Common Market and to improve cooperation between the Common Market and European countries.

In 1957, Holland imported 41,500 tons of plastics valued at approximately $30,000,000. During the same year, 27,610 tons of plastics were exported which amounted to a total of $18,000,000.

• An interesting patent covering adhesive bonds has been granted to the Research Association of British Rubber Manufacturers and the Minister of Supply in England. Natural rubber or rubberlike polymers are bonded to rigid polymeric materials by means of a tertiary butyl compound capable of generating free radicals which can react with both materials to be bonded and cause them to unite. The rubberlike polymers may be styrene-butadiene, nitrile rubber or silicone rubber, and the rigid polymeric materials may be vinyl polymers of all classes, unsaturated polyesters of the contact resin type or hydrocarbon polymers.

Tertiary-butyl perbenzoate is a convenient substance for the production of the necessary free radicals. The bonding of natural rubber to polymethylmethacrylate is described as an example of the process. The invention is applicable, for example, to the production of laminated sheets of rigid materials in which the interlaminate is rubbery, and to the bonding of a resilient mounting of rubber to transparent plastic cockpit covers.

• Synthetic resins containing aluminum are covered by a patent which has been granted to the Chemische Werke Albert. According to this patent, synthetic resins containing chemically-combined aluminum are made by reacting stabilized aluminum alcoholates with polyhydric alcohols and then distilling off the volatile components from the product. According to an auxiliary patent, these synthetic resins are claimed to be used as hardening agents for epoxide resins and also in compositions for surface coating and other purposes.

• Registration of trademarks is not merely a domestic affair. It is important to register trademarks in as many countries as possible. As the world shrinks daily, it is quite likely that because of increasing competition in Europe and other parts of the world, American trademarks will soon clash with others claimed to have been protected earlier. How eager other nations are to protect their trademarks can be seen by leafing through the trade papers of various countries.

Four trademark applications, including an American one, that appeared in one foreign journal are cited here. An English company has registered "Lockoblox" for toy building blocks. The firm is Shipton Plastics Ltd., Ferndown, Northwood Hills, Middlesex, England. "Cydac" for chemical products used in industry as accelerators for the vulcanization of rubber, has been registered by the American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y.

"Rholene" for plastics in the form of sheets, blocks, rods, tubes and shaped sections, for use in manufactures and included in Class 17, has been registered by the Société des Usines Chimiques Rhone-Poulenc, 21 Rue Jean-Goujon, Paris, France. "Hellfax" plastic in the form of foil and included in Class 7 has been registered by Dr.-Ing. Rudolf Hell, Grenzstrasse 1-5, Kiel-Dietrichsdorf, Germany.

• The Soviet Russian-Polish rubber industry is expanding. Presently under development is an industrial site in the region of Jaroslaw (Jaroslau) near Drohobycz, which is located in the former province of Galicia of the old Austrian-Hungarian Empire. Before 1914, Austria-Hungary had invested a tremendous amount of money in the development and exploitation of the oil wells located near Drohobycz. A number of American firms took part in this development and it is known that the Standard Oil Co. of New Jersey has been interested in these oil fields.

According to an article published in the Soviet Russian trade paper *Rubber and Resins*, the Soviets have great plans for the expansion of this region. During the next six years, additional factories will be erected and new industries will be started. Large-scale plants for production of rubber, synthetic rubber, and rubber and asbestos products are already located in this region. The Soviets claim that the largest tire factory in Europe is also located there. At the present time, a great deal of the raw material, especially grain alcohol for synthetic rubber, is imported from other regions at a yearly transport cost of 40 million rubles.

A petroleum conversion plant is planned within the region which will produce ethyl alcohol, butane, isopropylbenzol, ethylbenzol and other products required for the manufacture of divinylmethylstyrol rubbers. Divinyl (butadiene) will be produced by dehydrogenation of butane in a one- or two-stage process and methylstyrol by dehydrogentation of isopropylbenzol.

Production of these copolymer rubbers will largely eliminate the need for expensive natural ethyl alcohol. Other new plants will produce high-dispersion carbon black from cracked petroleum oils. Butadiene styrol and butadiene vinylpyridine latices and carboxyl latices will be produced for impregnation and improvement of tire

On the Continent

cord. New machinery and new materials, including viscose and nylon tire cord, will be introduced in the tire factory. Autoclaves will be replaced by high-production, vulcanizing presses, and high-speed rubber mixers with automatic weighing will displace milling in the production of other rubber components.

Experiments will be made with radiation vulcanizing using isotopes and high-frequency pre-heating, and electrically-heated vulcanizing machines will displace steam-heated equipment. New methods and machinery using the principle of freezing rubber will be utilized in the trimming and finishing of rubber components. Hot-formed asbestos, asbestos fabric and paper products will be produced largely for tractor components. New laboratories and machine shops to construct special-purpose equipment will form part of the planned new factories.

• Polycarbonates of high molecular weight can be produced from 4,4′dihydroxy-diphenylalkanes. These materials are manufactured by Farbenfabriken Bayer, under the trade name "Makrolon". The manufacturer claims that Makrolon combines a variety of valuable properties, including good impact strength at temperatures up to 135°C. (275°F.) and below —100°C. (—148°F.); good electrical properties; low water absorption, approximately 0.3-0.4 per cent; good weather resistance; and good transparency.

Makrolon is produced chiefly by injection molding and extrusion, but it can also be formed by any of the other conventional methods. Molded Makrolon parts are said to be tasteless; odorless; non-toxic and resistant to perspiration. Also, they are not stained by dyes and they possess good resistance to water, acids, brine, fats and oils as well as to petroleum hydrocarbons.

• Eastman 910 Adhesive has created quite a bit of interest in Europe and a number of trade papers have given reports on the bonding qualities of this adhesive. Many daily newspapers have also carried stories informing their readers of this American accomplishment. *Allgemeine Fleischer-Zeitung,* Frankfurt/Main (the trade paper for the butcher trade in Germany) and the *Spandauer Volksblatt,* a daily newspaper published in Spandau, Germany, have both devoted space to the new adhesive.

• The Russian economy devotes more and more attention to the efficiency of factory operations in order to increase production. *Rubber and Resins,* the Soviet publication, devoted a feature article entitled "Potentialities for Raising the Productivity of Labor in the Rubber Industry" to a discussion of this theme. It points out that the current five-year plan calls for a general increase in the productivity of labor. The rubber industry must boost its productivity by 31.8 per cent during this period and this must be achieved by locating and exploiting "internal reserves".

The article states that mass-production methods must be introduced and cites some instances in which improved mass production techniques have already increased production. The introduction of a pre-formed "stocking" in the manufacture of rubber boots increased production by 36 per cent. Organization of a new line in the sorting and packing shop at the Red Giant factory for rubber footwear, reduced 40 operations to 18; shortened the line by 300 feet; and reduced the stock in the pipeline from 250,000 pairs to 40,000-50,000 pairs. A "flow-sheet" is given which lists time for each operation, distance traveled, etc. In the same factory, it is reported, 35 tons of raw materials are transported in the course of preparation of one ton of the finished product (galoshes).

A big potential for increased production lies in the cut-down of tool or mold changes in press shops. A table shows the percentage of increased production, per shift, with a diminishing number of adjustments to the press. Each adjustment to the press can amount to 120 pairs of galoshes. At the Red Giant factory up to 1,500 tool changes are made each month and in the time lost, 175,000 pairs of galoshes can be produced.

Further observations are made on the load factor, on the calendering rolls and the value of keeping the rubber mix constant. Reference is made to a brochure called "New Organization in the Production of Industrial Hose at the Kauchuk and Leningrad RTI Factories," which details a number of measures taken to raise their productivity.

• The Montecatini Chemical Co. plans to build one of Europe's largest petrochemical plants at Brindisi, Italy. The plant will produce the entire range of derivatives of liquid hydrocarbons and is scheduled to start production in 1960. Investment will total approximately $33,000,-000 and construction was to have begun in April.

• Mixed polyesters are formed by the condensation of 1,5-pentane diol with mixtures of adipic and glutaric acids, according to a patent recently granted to Imperial Chemical Industries, Ltd. The mixed polyesters which are used as plasticizers for PVC, are said to be efficient plasticizers and to have good resistance to migration and to extraction by solvents.

• A reliable West German source has disclosed that in order to register a trademark in Russia, it is necessary that a treaty regulating trades and commerce between Soviet Russia and another country exist. The registration of the trademark in the country of origin must be documented and the registration will be valid only as long as the trademark is registered in that country. Application for registering a trademark has to be submitted to the patent office of the Chamber of Commerce of the Soviet Russian Republic in Moscow. Documents to be added to the applications are the Power of Attorney for the patent office certified by the Embassy of Soviet Russia in the country of origin; proof of certification of the registration of the trademark in the country of origin, also certified by the Soviet Russian Embassy; and a linecut or half tone engraving and fifty reprints.

Fees to be paid when registering a trademark in Russia are a registration fee of 170 rubles; a publication fee of 30 rubles; and a special fee for depositing the documents of 25 rubles. This is a total of 225 rubles. The necessary translations will be charged at 8 rubles for 100 words.

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- **Adhesive Bonding for Fibrous Glass Reinforced Plastics—H. A. Perry. $8.75.** A theoretical and practical manual on the joining of glass reinforced plastics. ☐

- **Adhesives for Wood—R. A. G. Knight. $5.00.** A guide and reference to the problem of joining components together. Considers components made of wood in one of its many forms and the joining of wood to metals and plastics. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice —A. X. Schmidt and C. A. Marlies. $12.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives; their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research —G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Rubber-to-Metal Bonding—S. Buchan. $4.00.** Discusses methods for bonding natural and synthetic rubbers to metals of all kinds, for use by those who manufacture rubber-metal units, and of interest to the rubber-minded engineer. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Adhesion and Adhesives: Fundamentals and Practice—F. Clark, J. E. Rutzler, Jr. and R. L. Savage (Editors). $10.50.** Papers read at a Symposium at Case Institute of Technology and a Conference in London, on the status of knowledge in adhesion. ☐

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STAFF REPORT

Bonding Wood Veneers and Joints

Quality is the only criterion used in this shop to judge the results of a wood bonding operation," explains Edward Heyman, custom cabinet and furniture maker. "By using hot animal glues almost exclusively, we can take advantage of a product that not only provides a strong wood-to-wood bond, but is workable sooner and sets faster."

For the last 45 years, Mr. Heyman's shop has been turning out handsome furniture pieces which have found their way into the homes of New York socialites and celebrities such as Victor Borge, David Sarnoff, Alfred Lunt and Jock Whitney. Individually designed and custom constructed, many of these tables, chairs, cabinets and beds are destined to become the museum pieces of the future. It is important, therefore, that the glue and gluing technique used provide joints and veneers that will give both service and longevity.

Almost every operation in his shop is done by hand, and Mr. Heyman points out that many of the techniques used would be unsuitable or impractical for a production line operation. "Many of our workmen are of Italian extraction, and they've brought with them tradition tested techniques that have not changed much over the last hundred years." However, he explains, far from indicating a resistance to improved modern methods, this lack of change in bonding techniques for custom furniture simply means that nothing *better* has come along. Animal glues may be some 3000 years old, but they're still the best bet for making strong wood-to-wood bonds.

Just to make sure, however, the shop is constantly experimenting with new techniques and glue products. For example, various resin glues were tried and rejected because it was found that they caused an amount of creep which could not be tolerated in this sort of work. Experiments with casein showed that

PREPARATION OF GLUE AND BRUSHES

For joint gluing, some of the workmen prefer a "brush" made by moistening a piece of rattan and hammering the end until it becomes fiberous. Glue solution is prepared by allowing the dehydrated particles to soak overnight in cold water. The swollen particles are then "cooked" until the melted glue forms a smooth solution.

those glues took longer to set than animal glues. In addition, they presented a problem in that they got extremely hard when set. Any squeeze-out that had to be removed tended to damage precision shop tools.

Not only do the shop's craftsmen keep a sharp lookout for new glue products which might improve or facilitate veneer or joint bonding, but routine checks are made on the quality of each order of hide glue received to make sure that it is up to standard. When a new bulk shipment of dehydrated glue is received, a small batch is made up for testing purposes before the glue is put into the shop.

The prepared sample is used to bond together two flat pieces of hardwood which are then set aside and allowed to cure for several days. At the end of that time, the pieces are separated by hammering a chisel into glue line. Unless the resulting break causes failure in the wood, the new batch of dehydrated animal glue is considered substandard. If the situation cannot be corrected through the use of an additive, the entire batch is shipped back to the manufacturer.

The preparation of the working supply of hot animal glue is a simple operation and one man generally prepares enough for all the various jobs that may be going on in the shop at the same time. Having roughly estimated the amount currently needed, he first prepares a cold mixture made of an equal amount of dehydrated glue and water. This is allowed to soak overnight in a covered pail so that the gelatin in the glue absorbs the maximum amount of water.

When the dehydrated glue has become thoroughly swollen, it is poured into a smaller pot and "cooked" at a temperature of no more than 145°F. until the glue is melted and forms a smooth solution. Agitation is supplied by hand stirring.

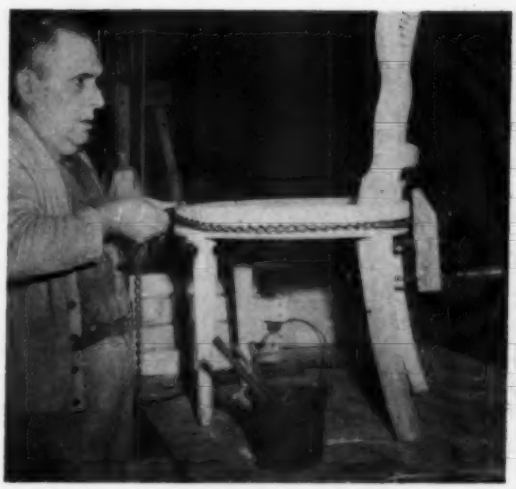
The prepared batch of hot animal glue is then divided among the individual glue pots assigned to each workman. To a limited extent, a workman assigned to a given job may alter the basic glue mixture to suit his own tastes and the requirements of the job at hand. For example, if he feels that he needs more workability he will probably add more water to his glue supply.

All glue pots are kept on the stove and maintained at a constant

BONDING A WOODEN CHAIR FRAME

Chair parts to be bonded are warmed in a steam box, maintained at 130°F., so that hot glue will be able to penetrate wood pores before a film is formed.

Corrugated dowels used to reinforce wood joints are dipped into the hot glue. The small indentations into which the glue flows make a better bond.



A special chain clamp is used to hold curved bonded pieces during drying. The regular clamp temporarily holds the chain in place during the adjustments.

workable temperature at all times. Since this is not a production line operation, the glue pots are brought to the work benches only when a man has come to a phase of his work requiring a wood-to-wood bond.

As has been pointed out before, the craftsman turning out these custom furniture pieces are allowed some latitude in suiting some of the standard techniques to their personal work habits or to what they feel are the needs of the job on hand. For example, in preparing glued joints many of the men prefer to use homemade "brushes" rather than standard equipment. These "brushes" are made by soaking a piece of rattan in water and then beating the end with a hammer until it comes apart into fibers. In this way they can afford the luxury of a new "brush" for each job. The pieces or rattan used in this way can be rehammered until they are too short for further use.

"In veneer operations," Mr. Heyman points out, "many of our men prefer to use an old fashioned whisk brook to apply the hot glue to the core stock for the veneer." Hot animal glues, incidentally, have been found to be especially invaluable in veneer work. Contact cements—used in some laminating operations—provide the same amount of bond strength, but animal glues permit a greater amount of play and the veneer can be picked up and moved to improve the match.

In preparing a veneer surface, the first step is to match the thin pieces of wood so that the grains form an attractive pattern. Individual segments are joined together with a paper tape that has an adhesive underside. When the entire pattern has been joined together, the veneer is ready for bonding to core stock. The latter is either bought in standard sizes or made up in the shop itself.

Core stock is prepared for this operation by being warmed in a steam box which is maintained at a temperature of approximately 130° F. "If the hot glue were applied to a cold surface," Mr. Heyman explains, "a glue film would form too quickly to allow for proper penetration of the glue into the pores of the wood." This technique is common practice within the industry though many glue experts feel that wood penetration is not necessary for bond strength.

The steam box, incidentally, is a homemade affair in the center of the shop. Essentially it is a big two-door box built over a series of steam pipes.

Bonding the Veneer

When the workman is ready to bond the veneer, both the taped wood grain pattern and the core stock are coated with hot glue and set aside to dry for a while. After the surfaces have acquired the right amount of tack—a factor which is determined by running the fingers lightly over the glue film formed—the veneer is positioned in place.

When the veneer pieces to be used in a given item of furniture are all completed, the segments are ready to be put into the shop's American Multi-Ton Wood Press. First, both the top and bottom of each piece is covered with newspaper and sandwiched between caul boards which have been previously warmed in the steam box. Newspapers are also placed around the sides of the press and the veneer pieces remain under pressure for approximately 12 hours.

During this time excess glue is forced out and absorbed by the newspaper. When the veneered panels are removed from the press, they are racked up in such a way that air can circulate over the top and bottom of each panel. They are allowed to stand this way for several days and then the tape and paper which have absorbed the excess glue are scraped off.

"Here's where another valuable characteristic of animal glue comes into play," Mr. Heyman points out. "Animal glue is non-staining and we don't have to worry about a veneer surface becoming chemically discolored."

In making wood joints, added strength is obtained by using animal glues in conjunction with wood dowels. Some furniture makers feel that the dowel holes should be made a bit larger than the stick so that the glue can flow around all sides. "We feel, however," says Mr. Heyman, "that a better bond can be obtained by 'corrugating' the dowels so that the glue can flow into the small indentations." Dowels are corrugated by hammering them through a toothed steel matrix.

Bonded joints are clamped together and the excess glue which is squeezed through is easily planed off. A special chain clamp is used to

PREPARATION OF A TABLETOP VENEER

Matched pieces of veneer are joined together with an adhesive-based tape. Before bonding the veneer to the core wood, workman tests for tackiness. After the bonded panel has been removed from the press and allowed to air-cure, paper and tape are scraped off.

hold curved bonded pieces—such as the frame of a chair seat—during drying.

On wood bonding jobs which for one reason or another are not handled within the shop, it had been the custom to use fish glue. Since the latter is in a liquid state it is more convenient to use on a job site. However, Mr. Heyman now feels that fish glue is slow setting and does not provide sufficient tensile strength. At the present time, phenol resin adhesives are used on outside jobs.

Very often the shop is called on to make repairs on valuable antique pieces. In these cases, the wood itself may often be somewhat deteriorated and pocked with worm holes. For work of this sort, the so-called "white glues" are employed almost exclusively. In reinforcing joints, very tight dowel holes are used so that when the dowel stick is inserted it acts as a plunger and forces the glue into the cavities of the surrounding area. The general result, Mr. Heyman explains, is to fortify the whole segment of wood.

"Until about 25 years ago," Mr. Heyman sums up, "many makers of fine furniture felt that the only really good glues were those that came from England. At present, however, animal glues of excellent quality are obtainable in the United States and until anything better for quality wood bonding shows up, most cabinet makers will stick to the proven techniques."

GLUE BATCH TEST

Sample of new glue shipment is tested by forcing apart bonded pieces of hardwood.

The break must cause failure in the wood for the batch to be acceptable.

Plastic-to-Rubber Bonding

It Had To Be Watertight!

The great popularity of skin diving has spawned an entirely new field of sports equipment relying for its operating efficiency on a strong waterproof bond between parts. For example, an exclusive feature of the Wide View Mask put out by Swimast is a one-way plastic purging valve adhesive-bonded to the unit's rubber body.

The purging valve permits the diver to instantly clear the mask of accidental water seepage. This is accomplished by a slight nasal exhalation through the valve, thus eliminating the problem of flooded face plates.

Production of the mask, handled by Swimaster's parent company, Pacific Moulded Products, Los Angeles, presented a difficult assembly problem calling for a strong watertight bond between the valve and the mask proper. The bond had to be one that would remain unaffected under conditions normally encountered given intermittant water immersion and changes in temperature.

After unsuccessful experiments with a rubber decyclizing process, as well as a wide variety of adhesives and bonding techniques, production engineers decided to test the recently available Eastman 910 Adhesive. The latter has as its main component a reactive material known chemically as methyl 2-cyanoacrylate. They found that the Eastman adhesive not only provided the absolute seal required, but offered production line advantages in that it is fast setting.

The adhesive is spread on the plastic valve preparatory to mounting it against rubber body of the swim mask in the jig.

The bonding technique involves positioning the body of the mask in a jig with the nose section firmly supported by a backing plate. After flowing the adhesive onto the edges of the plastic valve, the valve is immediately mounted in place on the nose section. To flow out and evenly distribute the adhesive so that a tight seal will be obtained, the two sections are clamped together for a short time before sending the mask along for the next assembly step.

Though Pacific's experience with the adhesive has been entirely successful, it should be noted that Eastman does not recommend 910 for applications involving long or continuous underwater exposure.

Economics of Corrugating Adhesives

A survey of some of the dollar factors affecting the design and installation of mixing, circulating and storage equipment

By MILLARD G. BREKKE and LEONARD H. LIPMAN
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In the manufacture of corrugated board there are only two basic adhesives used: sodium silicate and starch paste. However, the starch paste formula, which was invented by Jordan Bauer some 23 years ago, has been accepted by the majority of the corrugated box industry as its major adhesive, and more than 90 per cent of the combining plants in the United States are equipped to use starch.

Some years ago the cost of sodium silicate was slightly less than starch, but today starch is definitely the more economical adhesive. Almost all new plants are designed to use starch, and many older plants have converted to its use.

The design engineer in charge of plant modernization or new construction needs to know what equipment is necessary for the preparation, storage, and circulation of the starch adhesive. In addition, the space required for the equipment, the equipment cost, and the expected adhesive cost per 1000 square feet of production are vital to his planning.

Therefore, the expected production capacity of the new plant or the capacity of the modernizing plant becomes the jumping off point for the selection of the proper size mixing unit. Many in the industry consider a consumption rate of 1½ gallons of adhesive or 2.4 lbs. of dry starch for each 1000 square feet of board produced make for an efficient operation. These figures should be used for estimating equipment requirements. Some plants are able to operate at lower consumption levels.

If monthly production is expected to be between 10,000,000 and 15,000,000 square feet of board, paste mixing equipment should be large enough to produce between 750 gallons and 1100 gallons per day. We should examine our rate of use of the adhesive to be certain that the unit we choose will have sufficient mixing capacity to stay well ahead of consumption and not tie up a man for a full eight hours each day mixing undersize batches.

Let us assume that our combiner is a modern high speed unit, perhaps 85 inches wide. We expect our available paper width to be about 72 inches. With running speeds of 300 feet per minute and 72-inch wide paper, production will be approximately 108,000 square feet of board per hour. Allowing approximately two hours in which to mix a batch of paste we will have produced 216,000 square feet of board with an adhesive requirement of 324 gallons. We repeat: It is necessary to consider not only the quantity of board to be produced but the rate at which it will be produced and will consume adhesives.

Different Units in Use

There are a number of different sized units in use, but the corrugating industry has pretty much standardized on two sizes. The smaller will produce a batch of 333 gallons of paste at a time; the larger will produce 666 gallons. The smaller unit is considered large enough for plants producing up to 10,000,000 square feet of board per month. The 666-gallon unit will take care of plants producing up to 20,000,000 square feet of board per month and over.

The 333-gallon unit consists of a 147-gallon primary mixer and a 333-gallon secondary mixer, and usually one 1000-gallon storage tank. This type of unit will supply a single viscosity paste to the combiner. Its cost will vary from $6000 to $10,000 depending upon a plant's installation requirements.

The 666-gallon unit is the most

About the Authors . . .

MILLARD BREKKE is one of the country's outstanding corrugating adhesive and combiner experts. Previously associated with Stein, Hall and Co., Inc., he has published several articles on corrugating methods. During 1942-1946, Mr. Brekke was in the Armed Services.

LEONARD H. LIPMAN was formerly manager of the Corrugating Industry Department, Stein, Hall and Co., Inc. During World War II he was chief inspector in charge of production quality and statistical quality control, in the Illion, New York plant of Remington Arms Co.

universally used in the industry. It consists of a 232-gallon primary mixer, a 666-gallon secondary mixer, and a 1500 gallon storage tank. Many units have been modified to supply a dual paste system. We then need an additional 1500 gallon storage tank.

Units of 666 gallons range in cost from $10,000 to $14,000. They can be elaborated upon to include twin mixers with four to five storage tanks to take care of not only dual viscosity systems but of weatherproof adhesives as well. These units will cost upward of $20,000. None of the above cost figures include circulation piping to the combiner, electrical wiring necessary, nor have we included the cost of the return pumps and motors to complete the circulating system.

In the selection of a suitable location for a starch paste mixing unit and space to be allocated for the storage of raw starch and chemicals, we consider the 333-gallon unit should have at least 100 square feet, preferably 15 to 18 feet in length, and six to seven feet in width. Starch and chemical storage will require an additional 210 square feet or a total of 310 to 350 square feet. The overall height in this area should allow for double or triple stacking of starch pallets with a minimum of ten feet.

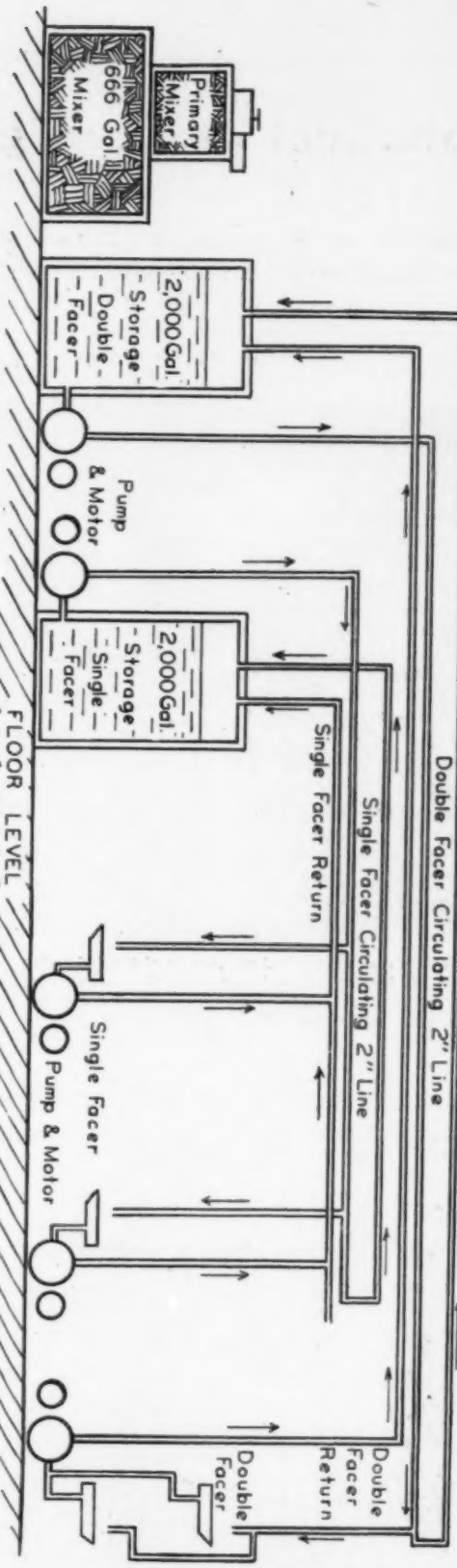
The 666-gallon unit requires 35 square feet for the mixing unit, 64 square feet for each storage tank, eight square feet for each pump, and somewhat larger mixing and raw material storage areas. Perhaps 475 to 500 square feet will be sufficient with ten to 12 feet of head room. Table I will prove helpful in determining your equipment needs.

Calculating Costs

About this time it becomes necessary to calculate the approximate adhesive cost per 1000 square feet of production. The final figure will be dependent upon the factors used in arriving at it, and the method of calculation. Most plants in the industry only consider the cost of the starch and chemicals delivered at the plant. With these basic figures they have a simple method for comparing daily adhesive costs.

In some plants management is interested in the complete overall cost for adhesive preparation. Table II will be of interest to those desiring more detailed cost figures. The figures are, of course, approximate and must be calculated for each plant

Typical Circulating and Overflow Piping Arrangement for Two Viscosity System Using a 666-Gallon Mixing Unit



The schematic diagram above shows the piping arrangement for a 666-gallon mixing unit with two 2000-gallon storage tanks. Units of this size range in price from $10,000 to $14,000 exclusive of circulation piping to the combiner, electrical wiring, and the cost of return pumps and motors. Additional storage tanks can be added to take care of weatherproof adhesives.

Table I—Equipment Costs and Sizes Based on Expected Production

Monthly Production	*Approximate Unit Cost*	*Area*	*Unit Size*
10,000,000 sq. ft.	$ 9000	350 sq. ft.	333 gal.
20,000,000 sq. ft.	12,000	450 sq. ft.	666 gal.
40,000,000 sq. ft.	15,000	550 sq. ft.	666 gal. plus additional storage
60,000,000 sq. ft.	20,000	600 sq. ft.	Twin 666 gallons
80,000,000 sq. ft.	25,000	650 sq. ft.	Twin 666 gal. plus additional storage

The photograph above shows the actual appearance of the 666-gallon mixing system diagrammed on page 25. A setup such as this requires 35 square feet for the mixing unit and 64 square feet for each storage tank. Units of this size are recommended for plants producing 20,000,000 or more square feet of board monthly.

Table II—Cost Breakdown For Formulation of 333-Gallon Starch Batch

	Cost/Lb.	*333 Gal. Formula*	*Cost/Batch*
Corn starch—East Coast	.0739	600 lb.	$44.34
Unloading car	.00075		.45
Caustic soda	.06	16 lb.	.90
Borax	.05	15 lb.	.75
Formaldehyde	.07	3 lb.	.21
Tap water		2397 lb.	.07
Steam—cooking time			.12
Electric motors & lights			.08
Labor—2 hr./batch @ $1.86			3.72
Floor space @ $50/1000 1 batch/day 500 sq. ft.			1.25
Maintenance repairs $400 yr.			1.10
		Total	$52.99

depending on its location and labor costs.

Assuming a consumption rate of 1½ gallons of adhesive per 1000 square feet of board, the calculations in Table II will provide us with a cost of $.24 per 1000 square feet. If we use only the starch and chemical raw material costs the adhesive will then cost approximately $.21 per 1000 square feet. Using the figures in Table II, the overall cost of adhesive per gallon comes to $.159; the cost of chemical, including starch, is $.138 per gallon; and the cost of the starch alone is $.133 per gallon.

It is possible today to operate with lower adhesive costs by the selection of various types of starch. The most successful starches being used today are corn starch and tapioca. Depending uopn the location of your plant, you may find imported corn starch or imported tapioca will cost less per 100 lbs. delivered at your plant than domestic corn starch. The quality of domestic and imported starches is quite uniform; therefore the delivered cost should be the determining factor in starch selection.

In some plants costs are further reduced by lowering the solids content of the adhesive mixture. This is best done by trial and error for an individual operation. For example: a basic starch formula for a 333 gallon mix would be as follows:

Primary Mixer:

(1) Add 50 gallons of water. Heat to 110° F.
(2) Add 80 lbs. corn starch. Agitate until dispersed.
(3) Add 15 lbs. caustic soda which has been dissolved in three gallons of water.
(4) Heat to 160° F. Hold 15 minutes under agitation.
(5) Add 60 gallons cold water. This is the completed carrier and is ready for use in Step #9 below.

Secondary Mixer:

(6) Add 185 gallons water.
(7) Add 15 lbs. borax.
(8) Add 520 lbs. starch (corn or tapioca).
(9) Slowly drop carrier portion prepared in Step #5.
(10) Add 1 quart formaldehyde.
(11) Agitate approximately 15 minutes before checking viscosity.

You will notice that the basic formula calls for a total of 600 lbs. starch. Under some conditions you may be able to use 500 or 550 lbs. and obtain a satisfactory bond.

The actual production of the adhesive is routine provided the man as-

signed to the preparation will carry out instructions and prepare each batch exactly as instructed. This is not an operation which fares well in the hands of an improviser or careless individual. Each plant should have at least two or even more people trained in the preparation of adhesives so that emergencies can be covered successfully.

Supervisory Checks

Supervisors should make careful and regular checks of the housekeeping, cleanliness, and general activities of the paste mixer and the area in which he operates. The most successful plants are noted for the cleanliness of their paste mixing areas.

A list of necessary equipment for the paste mixer might prove helpful:

(1) Scale to weigh to 100 lbs. accurately.
(2) Grocer's scoops for borax and caustic soda.
(3) Sieve for starch paste when testing viscosity.
(4) Rubber gloves and apron for handling caustic soda.
(5) Respirator for handling caustic soda.
(6) Goggles for handling caustic soda.
(7) Pails to weigh out chemicals.
(8) Electric clock with sweep-second hand for checking viscosity.
(9) Broom, scraper, rags, etc., for cleaning.
(10) Oil can and grease gun.
(11) Viscosimeter correctly calibrated.
(12) Locker for equipment, and table on which to complete reports.

In summing up, the selection and installation of a paste mixing unit for a corrugating plant is so thoroughly standardized today that it is not necessary to "go off the deep end." The equipment available is dependable and will produce high quality adhesives day after day for many years. The writers personally know of installations made in 1935, 1936, and 1937 which are still making paste as efficiently as some of the newest units available.

Color Control of Tile Mortar

Rotary blending assures batch to batch color consistency of cement specialty

America has become color conscious and vividly colored tile combinations are helping to make our homes, office buildings, hospitals and factories more interesting both inside and out. Effective use of tiles, however, depends not only on the color consistency of each square, but on hue balance and consistency of the tile mortar used in the acutal installation.

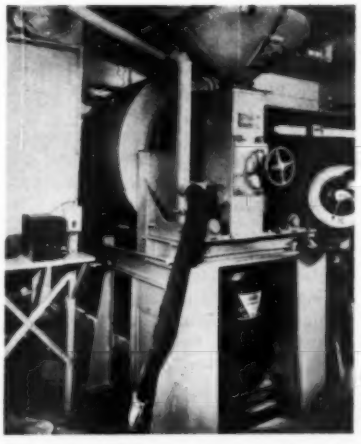
The maintenance and reproducibility of exact mortar coloration from batch to batch has been a persistent industry problem. At Upco Co., Cleveland, manufacturers of Tilemate mortar and Hydroment joint fillers, this problem has been brought under control by switching from ribbon blending to rotary batch blending of components. According to J. A. Todd, vice-president, this exact blending method has played a big part in helping the company to meet and exceed rigid standards set up by the Tile Council of America and the U.S. Department of Commerce.

To achieve thorough color dispersion and eliminate guesswork at the job site, Upco uses a 25-cubic-foot rotary batch blender engineered and fabricated by Sturtevant Mill Co., Dorchester, Mass. This single unit replaces the four ribbon blenders previously used. Though its capacity varies with the bulk density of the products being blended, the unit will handle as much as 2200 lbs. at a time, and intimately blends six or more ingredients within three to four minutes.

Material is received from a weigh hopper which feeds directly into the revolving unit. A series of revolving scoops seizes the entering powders and carries them to the top of the chamber where they are cascaded into the blending chamber. The drum's revolving action forces the materials to the middle, adding another mixing action with no separating effect. A swinging chute or chutes produce an additional lateral mixing action to assure a perfect blend.

Should a following product be of a different color, the rotary blender can be cleaned out by introducing a small amount of quartz. However, if Upco is switching from a dark to a light color, the unit is sometimes swept and/or vacuumed by removing a dogged, gasketed manhole which permits access to all moving parts and the inner, fully-rounded recesses.

Exact color control achieved by this blending process has become an important feature of the company's advertising literature aimed at architects and contractors. The company stresses the ability of its products to make the planned color scheme a construction reality.



Rotary batch blender at Upco. The unit's four-way action assures color dispersion and particle intermingling.

Pneu-Vac collectors delivering directly to a mixer and kettle unit. The system is labor-saving, clean and safe.

Pneumatics for Adhesive Production

By JOHN FISCHER
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Materials Handling Division
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Bulk materials handling is not a stranger or newcomer to the adhesive industry. In the last few years, the realization that pneumatic conveying can be a vital production tool has resulted in a spectacular rise in the number of air handling systems in use. The greatest number of such systems is found in plants manufacturing the adhesive bases—vegetable bases, such as starch and dextrin; animal bases such as gelatin; and resin bases, phenolics, ureas, polyvinyl alcohols and the like.

Nearly all of the advantages and benefits derived from conveying by air, by these manufacturers of bases, can be achieved by the small and large adhesive manufacturer—and there are additional advantages, not so readily apparent, which are particularly profitable and worthwhile.

The most important features of handling materials pneumatically are cleanliness, safety, flexibility, labor saving, low maintenance and easy automation. Let's consider each of these in turn.

Cleanliness—It is not necessary to extend one's imagination very far to visualize the housekeeping advantages of moving material within the relatively restricted area of piping and duct work—especially where it has been customary to handle powdered material in bags. Not only can dusting be controlled easily, but there are attendant benefits, such as reducing exposure of personnel to potentially allergenic substances. Housekeeping chores are appreciably simplified, and expensive materials which would otherwise be lost in the air are retained in the system.

Since the product is airborne, and because the velocity with which it travels is reasonably high, pneumatic systems are considered self-cleaning. Very little product, if any, remains in the conveying line at the conclusion of the run. This provides a two-fold benefit: freedom from inter-batch contamination, and complete elimination of infestation. Many of the products handled tend to foster insect or organic growth, but the pipeline's freedom from crevices, corners, and other harbors completely eliminates this danger. Air conveying thus fulfills every requirement of cleanliness for the strictest industrial, sanitary, or economic standard.

Safety —Virtually all moving parts of a pneumatic system are located or can be located at points far removed from those at which an employee or operator comes in contact with the system itself. The blowers and compressors which create the driving force for these systems are always located at the terminals of the system, and are usually completely isolated from the operator. This provides a high degree of mechanical safety. While this latter factor is important, it is overshadowed in significance by the chemical safety inherent in pneumatic conveying systems.

Dust explosions are an ever present hazard in adhesives manufacture, because of the nature of the base material. The design of pneumatic systems makes it a rare case indeed where the dust-air mixture even approaches the critical proportions which might lead to an explosion. Rotary vane airlocks and feeder valves used as basic components on these systems have long been recognized as effective explosion check devices; and pressure vents and pressure relief panels are easily provided for. More recently, ingenious explosion detection and suppression devices, utilizing instruments which are sensitive to the rate of pressure rise, have been developed. These can easily and readily be installed in sensitive or critical spots.

Flexibility—Wherever pipe can be

run, a pneumatic conveying system can be used. They are free from the inherent rigidity of mechanical systems, and, although they require more power as a general rule, the ease with which long distance and many angles can be traversed soon equalizes the factor of power.

Flexibility also provides a contribution to housekeeping. Piping can be run in corners, under floors or along walls, freeing much valuable space and reducing the work involved in keeping the areas clean.

Labor Saving and Reduced Raw Material Cost—Inplant transport of bags, drums and other containers of material can be minimized by using pneumatic conveying from the warehouse or storage point to the point of use. Skids, pallets, hand trucks and similar devices can be eliminated. The labor savings realized in this manner can be substantial.

Another significant savings made possible by pneumatics is that brought about by bulk purchasing. Most basic materials for adhesives manufacture are shipped in covered hopper cars, bulk trucks, and large unit containers. Packaging and bagging cost savings can pass on to the user, as well as the savings which result from lower freight costs. These transport units can be pneumatically unloaded into bulk storage containers, such as large tanks, located either indoors or outdoors.

The bug-a-boo of condensation and extreme temperatures in outdoor storage has been largely eliminated in recent years, and may be considered for all practical purposes to be nonexistent. This method of handling does away with the stevedore labor of unloading, and eliminates as well much of the dust, dirt and danger of contamination attendant to manual transfer. In some installations, effective and appreciable savings have been made by locating the storage on the roof of the building, and utilizing gravity discharge to processing.

Low maintenance—There are only two principal points of maintenance in a typical pneumatic conveying system, whether it be positive or negative pressure. These are at the inlet and discharge points. The equipment at this point is usually a rotary vane airlock or feeder. When properly designed for the material which they are to handle, and when the necessary engineering features are incorporated into them, they can run for years without attention. Consequently, no maintenance other than routine inspection and lubrication is necessary.

Pneumatic systems for handling bulk materials are gaining increased acceptance in the adhesive industry. The photo above shows the pneumatic setup at the Morningstar-Paisely plant to handle the blending and bagging of starch and other products.

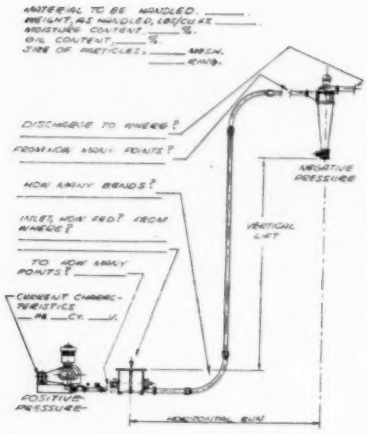
Automation—The simplicity, dependability and flexibility of air handling lends itself to automation. By electrically integrating the various units at a central panel, it is possible to have one man to control the complete flow of material through a plant. Panels have been developed, along with safety devices and indicators, to the point that they can relate at a glance the availability of material, the demand for material at a process, and both the routes which are in use and those available for use. When panels are laid out graphically, they can be manipulated with ease by a relatively unskilled operator, since fail-safe devices can be incorporated into them to minimize human error.

Caution must be exercised in the consideration of automation, however. A careful evaluation should first be made of the need. Instances abound where it is necessary to have an experienced operator available for control of the process. This man can then be on hand for making manual connections or changes. In such cases, automation is obviously unnecessary. In addition, automation is a luxury where only infrequent, quickly-made changes are necessary. The element of human judgment is also worth considering. It can never be replaced by automatic controls. Where judgment is required, automation may have to take a back seat.

The features we have just outlined apply to large and small volume producers and users alike. These features have made it mandatory for large manufacturers to adopt pneumatic conveying. The small manufacturer and consumer of bulk products must weigh all factors more carefully, but with each passing day, the decision is becoming easier. However, there are some advantages of pneumatic conveying that can be very important to the small manufacturer and compounder of adhesives—even though the large raw material manufacturer may not be too greatly concerned with them. One of these is multiple batching—formulation.

Where it is desired to add a number of different ingredients at either single or multiple processing points, it is frequently advantageous to station a dump hopper feeding a pneumatic conveying system at a central weighing station. This can be in the warehouse, or in an isolated room. Concentration of ingredients at one point, and the convenience of the weighing operation at this point lends itself to improved control and elimination of error. This is the simplest aspect, but the problem and process of batching or of continuous additions of a multiplicity of ingredients has many possible solutions.

Scales, automatic weighing feeders,



The schematic diagram above outlines some of the basic information needed to design a pneumatic handling system.

or volumetric feeding devices can be placed at either end of a pneumatic conveying system. They can be supplied from storage bins, small tanks, or by manual dumping. Electrical interlocks regulating the action of all units are easily worked into such systems. Blending can be achieved by the same general process, although intimate mixing in transit is not yet a proven characteristic of pneumatic conveying.

In any form of high speed transfer, some particle size reduction can be expected. There are processors and manufacturers to whom such degradation is important. It can only be said here that a reasonable amount of control can be exercised by minimizing the number of bends in the conveying line, by carefully controlling the conveying velocity, and by sizing the conveying line in such a manner that the loading minimizes random movement of the particles.

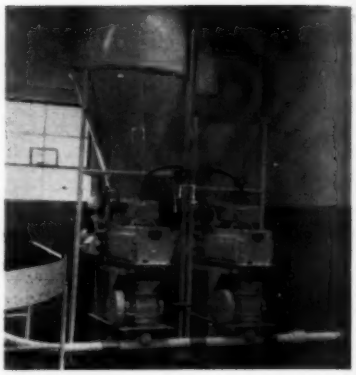
In most cases, degradation can be kept within the limits of tolerance especially within those limits established by mechanical handling methods. Many delicate materials, such as flaked gelatin, are being handled pneumatically with success and with minimum breakage, but where a serious question exists in the mind of the potential user, conveying tests should be made and the available limits of tolerance accurately established.

Segregation in pneumatic conveying—that is, the potential separation of mixtures containing components of different bulk densities—is frequently a matter of some concern. Exhaustive tests have been made, which prove rather conclusively that it is infinitesimal. In practically all cases where segregation has been reported, it has been proved that the segregation occurs after the material leaves the conveying system. This applies to gross mixtures of heavy and light components, as well as to mixtures containing micro ingredients or trace ingredients.

Materials which are moisture sensitive, or which readily absorb moisture can be handled easily in pneumatic systems. A number of expedients are used to accomplish this, the simplest one of which is that of using the same conveying air over and over again. An equilibrium is reached almost instantaneously between the air and the material, so that transfer of moisture cannot occur. By the same token, materials which contain moisture or solvents can be handled without loss of the volatile components.

Pipeline conveying makes it possible to handle a sensitive, toxic or explosive material through a complex processing train, from unit to unit, without interruption or exposure. Systems using inert gas for this purpose are common, and thoroughly reliable. Gas usage is small, after the system is initially charged, and can easily be determined and evaluated.

Where a number of processing trains are located side by side, utilizing gravity as a conveying medium, continuity can be facilitated by using pneumatic systems to lift the material from the bottom of one train to the top of the next. Since pneumatic systems are self-cleaning, this has enabled interesting economies to be effected, particularly in cases where sensitivity to color change exists.



Typical batching arrangement showing a gravimetric feeder discharging through an airlock into the pneumatic conveying line.

Many other potential uses for pneumatic conveying will recommend themselves to the adhesive manufacturer. One such function is cooling, especially where raw materials which are heat sensitive are to be pulverized or ground. By using negative pressure conveying systems to draw large volumes of air through the grinding device, as well as for conveying, much of the heat input to the grinder can dissipated, and the production rate of heat sensitive material can be considerably improved thereby.

In addition, fines separations can to some extent be effected by pneumatic conveying. This is usually a coarse separation of fines from larger size particles, and is not nearly as precise as screening. Air systems can also be used as devices for heat transfer and for drying, but unless other considerations intervene, are usually not economical for this purpose. Where combined functions are indicated, such as drying and conveying together, effective application has been made.

The manufacture of adhesives is a relatively new and fast growing addition to the field of American industry. Pneumatic conveying is also new, and its growth trend is remarkable. The future progress of each of these expanding fields can be effectively complemented by the other.

About the Author . . .

JOHN FISCHER is chief engineer of the materials handling division of Sprout, Waldron & Co., Inc. During the war he worked as a chemical development engineer for Sylvania Electric Products. Mr. Fischer received a bachelor's degree in chemical engineering from Yale University in 1938. He holds a professional engineering license for the State of Pennsylvania.

Latex in Adhesives

By RAYMOND A. STONE
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Natural latex is obtained by tapping an Hevea Brasiliensis tree. Approximately two inches of bark are removed in one month of daily tapping.

Before considering adhesives made from latex, it might be well to define what we mean by latex? Why is latex useful in adhesives? What kinds of latex are particularly useful in adhesives?

For the purposes of this article a practical definition of latex will be more useful than a highly technical one. Let us, therefore, define latex as a relatively stable, fine-particle size aqueous suspension of a polymer which upon drying forms a continuous elastic film.

Now, why is latex so useful in adhesives? Keeping in mind that there are several different types of latex we can next examine what properties they all have in common with good raw materials for making adhesives?

The first and most important property of latices in adhesives is that by themselves or mixed with other materials they have specific adhesion for a number of non-porous surfaces that are otherwise very hard to hold.

Second, latex is useful because when it dries it forms a water-resistant film. This means water base adhesives made from latex not only have many of the advantages of aqueous base adhesives, but are water-resistant as well.

A third attractive property of latex is its broad compatibility. Latex can be mixed with all sorts of modifiers, thickeners, resins, solvents, and stabilizers to get just the right properties needed for a specific adhesive operation.

Broadly speaking there are two different types of latex: natural and synthetic. Natural latex is obtained from the Hevea Brasiliensis tree which grows in Malaya, the Netherlands, East Indies, Ceylon and Liberia. The latex occurs primarily in the inner bark of the branches and trunk of the tree which is tapped by carefully making a diagonal incision through the outer bark. As the latex exudes from the tree, it runs to the lower end of the cut and is collected in a glass or aluminum container.

A surprisingly small amount of latex is obtained from each tree. In fact, 50 to 100 trees are often required to obtain one drum of latex per year.

Bacteria in Latex

Natural latex contains some twenty-three different types of bacteria. It therefore has to be preserved almost immediately to keep it from spoiling. Many preservatives have been tried for this purpose but ammonia is still the one most widely used.

There are several different kinds of synthetic latex; however, only three of these are widely employed in adhesives. They are: Buna S, Buna N and neoprene. These, as well as all other synthetic latices, are made by a process known as emulsion polymerization. In this process highly reactive small molecules known as monomers are joined together into a very long chain known as a polymer. If all the molecules being joined together are of the same kind, the polymer is called homopolymer; if they are of two different kinds, it is called a copolymer; if three, a terpolymer, and so on.

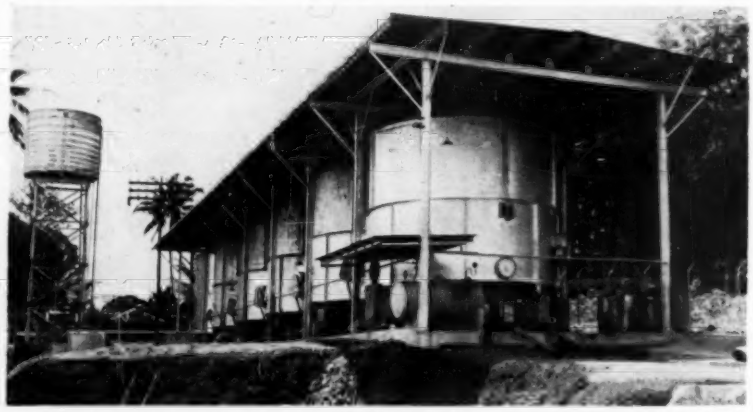
Emulsion polymerization is simply polymerization carried out in the emulsion state. The monomer or monomers are suspended in water by means of an emulsifying agent such as soap. Then, ordinarily with heat and a catalyst, they are polymerized to form an emulsion polymer or latex. Let us now examine the properties of specific latex types, the adhesives made from them and their uses.

Natural latex is available in several solids concentrations. At 40 per cent solids it is called normal latex, the concentration at which it is drawn from the tree. Normal latex is concentrated to 60-62 per cent solids by centrifuging—the same process that is used to convert milk into cream. Latex concentrated in this way is simply called "centrifuged latex." It is the latex type most widely used in adhesives.

Another variety of natural latex contains 60-68 per cent solids and is known as "creamed latex." As its name implies, it is made by creaming normal latex.

A super-concentrated latex called "Revertex" is made by heat concentrating centrifuged latex. It contains approximately 72 per cent solids.

The most unusual property of natural latex is that when it dries it is self-adhesive. It sticks to itself, but



At a Goodyear creaming plant in Malaya, after ammonia and a creaming agent are added to raw latex, it is pumped into 50,000-gallon tanks and the rubber-rich cream allowed to rise to the top.

not to anything else. A number of interesting and important adhesive applications are current in which this unique cohesive property is utilized. For example, natural latex adhesves are used in making dry seal envelopes, shirt bands, self-seal cartons, self-seal mattress bags, cohesive paper and, most surprising of all, shoes.

While uncompounded natural latex will stick only to itself, it can be made pressure sensitive so that it will stick to almost anything else by the addition of the proper resin. Resins most often added to make natural latex pressure sensitive are polyisobutylene, rosin esters, and terpene resins. Pressure sensitive natural latex adhesives are used in the manufacture of masking tape and in making self-sticking labels.

Paper-To-Paper Bond

Natural latex has another unusual property. A drop of latex will form a paper-to-paper bond almost instantly. You can readily see how "instant set" natural latex adhesives would have a number of industrial applications. For example, they are used in sealing bags and in certain splicing operations.

Besides these rather specialized applications, natural latex adhesives are used in laminating aluminum foil to paper, in the manufacture of automobile bodies, in the fabrication of carpets, for setting bristles in brushes, and in a wide variety of cloth laminating operations.

The synthetic latex most widely used in adhesives is Buna S also known as GR-S and more recently as SBR. Buna S latex is a copolymer of butadiene and styrene. There are thirteen different types of Buna S which range in solids content from 40-60 per cent. They also differ in their emulsifying agent and in the ratio of butadiene to styrene contained.

The most popular one is GR-S 2000. It contains approximately 40 per cent solids, uses rosin soap as its emulsifying agent and has a 50-50 ratio of butadiene to styrene. Why is Buna S so popular among adhesive chemists and what kinds of adhesives are made from it? Buna S is the least expensive latex available and, of course, this is important. But —even more important—it is versatile.

It can be compounded to stick to all kinds of surfaces—steel, paint, polystyrene, Saran or pliofilm, cellophane or cellulose acetate, glass, wood, cloth, etc. Buna S adhesives are used in the manufacture of many every-day items such as steel wall partitions, foil-fiberglass laminants, envelope windows and gloves. It is also used in sealing and labeling cans, as a padding adhesive, in applying labels to plastic articles, and in applying tax stamps to the plastic caps on whiskey bottles. In addition, Buna S is also used to make floor mastics primarily for rubber and vinyl tile.

Neoprene latex was the first man-made latex. It is a homopolymer of chloroprene whose method of manufacture was discovered by a Catholic priest, Fr. Nieuland, of Notre Dame University. Neoprene latex was then synthesized by W. O. Carothers, one of the the greatest polymer chemists of the twentieth century. Like Buna S, neoprene is available in several modifications. These have solids contents from 37.5 to 60 per cent. Other differences are in the respective molecular weights of the polymers and in the stability of the latices.

Neoprene latex has outstanding adhesion and can often be used interchangeably with Buna S although it is considerably more expensive. In addition, because of its high chlorine content it does not support combustion. This makes it the raw material of choice wherever a fire-resistant adhesive is required.

One application in which the fire-resistance of neoprene latex is important is in the manufacture of fiberglass laminates used in insulating household walls. By far the largest use for neoprene latex adhesives, however, is in laminating foil to paper. Laminated foil is used in making beer label stock, foil cartons, gift wrap paper, and foil bags.

The third latex to be considered here in Buna N, a copolymer of butadiene and acrylonitrile. Like GR-S and neoprene, it is available in several varieties which differ in composition (ratio of butadiene to acrylonitrile), in particle size, solids content and stability.

Buna N latex has specific adhesion for vinyl film. One of its most important uses is in laminating vinyl film to asbestos in the manufacture of vinyl floor tile. Buna N is also used in laminating vinyl to hard board for automobile interiors, as a tiecoat in the manufacture of vinyl masking tape and vinyl surgical tape, as a primer to adhere vinyl plastisols to paper, and in bonding vinyl coated fiberglass to aerocor.

About the Author . . .

RAYMOND A. STONE has worked in the latex and emulsion field for the past 20 years. Holder of several patents on adhesives, he obtained his B.S. in chemistry from Loyola University, Chicago, Ill.

Although latex adhesives have many fine qualities, they are not without limitations—nor are they a cure-all. Despite the most expert compounding, on certain types of adhesives equipment the machining properties of latex adhesives are often something less than satisfactory. In addition, because they are very water-resistant, if they should dry on any of the machine parts they are difficult to clean. Finally, and this is particularly true of GR-S and neoprene, they have a somewhat unpleasant residual odor.

However, despite these limitations, as can be easily seen latex adhesives are playing a very important role in a wide variety of chemical bonding applications. As new and better latices are developed for use in making adhesives, we can expect that latex adhesive will continue to grow in importance in the years to come.

Typical uses of latex adhesives include laminating composition felt with fabric for auto trim padding or work gloves, and foil to glass fiber for insulation material.

Bonding Vinyl-to-Metal

Contemporary architectural trends are towards making one room serve the purpose and function of several through the use of "moveable walls" which can quickly transform a given area. Often made of vinyl-coated fabrics adhesive-bonded to flexible frames, the practicality and serviceability of these folding partitions depends to a large extent on the strength of a bond that was literally designed to be pulled.

Production operations at New Castle Products, Inc., New Castle, Indiana, offer an interesting example of this critical use of adhesive fastening. As the largest manufacturer in the flexible partition industry, New Castle maintains three production lines for bonding cloth-reinforced vinyl to the front and rear edges of the metal frame used in its "Modernfold" doors.

In choosing an adhesive formulation which would meet company production requirements, New Castle engineers had to take into consideration a variety of factors. For example, ease of application was important since the production lines are "manned" by women. Another consideration of prime importance was the fast "grab" essential for the maintenance of projected production schedules and for general operating efficiency. Additionally, it was important that the adhesive selected would not stain the pastel-colored vinyl often used.

However, since the basic function of the finished doors involves frequent pulling and moving, production engineers were most concerned with obtaining an adhesive with a higher peel strength than is normally encountered in bondants for vinyl. As the result of the co-operative preliminary evaluation work carried on by company personnel and New Castle's adhesive supplier, a new formulation, Bondmaster G483, was tailored to meet all of the requirements.

The edges of the vinyl-coated fabric and the posts of the metal frame receive a spray application of adhesive.

The major part of the door has already been assembled by the time it reaches the spray station on the production line. At this point the adhesive is applied in an easily controlled spray so that it covers only the narrow area of the metal posts and the edges of the viny-coated fabric. Any accidental over-spray can be simply removed with a rag dampened in naptha.

The vinyl can then be fitted and folded against the posts. Later, gaskets are pressed into place against the vinyl edge and the hardware is installed to complete the door. Although a firm bond develops instantly with G483, sturdy bonds can still be achieved even up to 30 minutes after the adhesive application. This margin is important should there be some unexpected delay on the production line.

Note: Bondmaster G483 is manufactured by Rubber & Asbestos Corp., Bloomfield, N. J.

Adhesive Deterioration in Metal Bonds at High Temperatures—Part I

By J. M. BLACK and R. F. BLOMQUIST
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U.S. Department of Agriculture
University of Wisconsin

1—Studies of adhesives by infrared spectrophotometry

In this phase of the work, unsupported films of the adhesive were analyzed by infrared absorption to observe the changes in the chemical structure of the adhesive with progressive curing and aging at elevated temperatures. It was recognized that the application of the infrared absorption technique to complex materials such as highly polymerized phenol-epoxy resin adhesives would serve only as a qualitative measure of gross chemical changes occurring in the adhesive.

The absorption spectra of the various adhesive films were determined on a double-beam infrared spectrophotometer in the 2- to 16-micron region.

After considerable experimentation, the most satisfactory method for preparing unsupported adhesive films, suitable for infrared analysis, was solvent casting of the adhesive on a polished glass plate. Dry films about 0.001 inch thick were obtained consistently by casting a wet film of the adhesive on the glass surface by means of an accurately machined doctor blade designed to give a wet film 0.002 inch thick.

The solids content of the adhesive was reduced to 60 per cent by thinning with ethyl acetate before casting. The cast films were then precured and cured as desired on the glass plate by heating in ovens or on the platens of a press. To remove the film from the glass plate, the cured film was immersed for one day in distilled water and then removed from the glass with a sharp razor blade.

The films were then dried in vacuum at room temperature for 16 hours prior to analysis. The dried films were mounted over a one- by two-inch opening in an aluminum film holder to hold the film in place during subsequent heat aging and spectrophotometric analysis.

The initial work was conducted on a simple adhesive formulation, FPL-891, (Appendix), composed of 12.5 parts by weight of phenol resin (Durez 16227) and 2 parts by weight of epoxy resin (Epon 1001) in 2 parts by weight of ethyl acetate solvent. Later studies included more complex formulations employing curing agents and thermal stabilizers.

The infrared absorption spectra of typical films of FPL-891 adhesive after initial precure, cure, postcure, and aging at 550° F. in nitrogen and in air are shown in Figures 1 and 2. All results reported were from analyses on portions of a single film, cast and cured at one time and then separated into portions for further treatment and exposure as indicated on the graph.

The most significant change in the absorption spectra with curing, postcuring, and aging at 550° F. was the increased absorption occurring between 6.0 and 6.3 microns and the broadening and shift of this band to the left with more cure and heat aging of the film. The band at 6.1 microns after curing for 60 minutes at

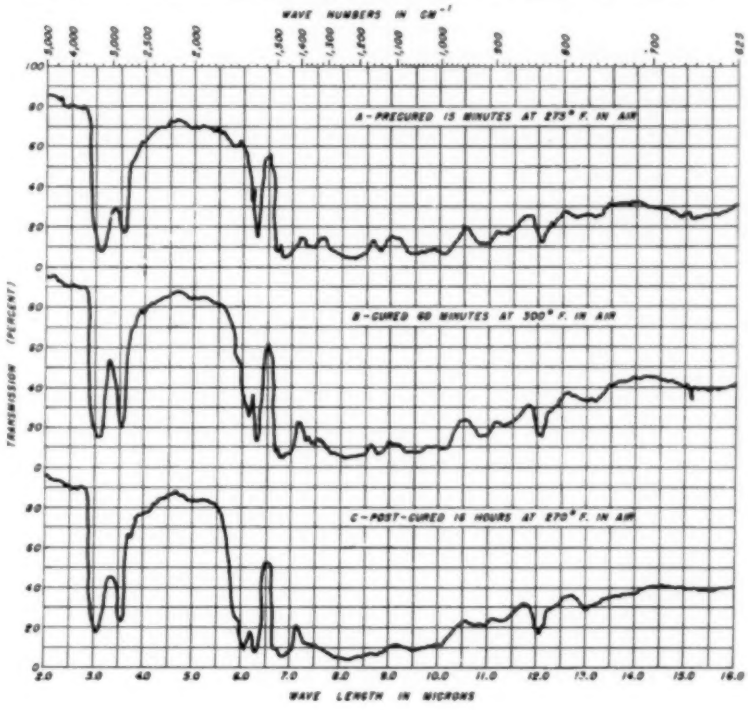
The purpose of this study was to perform related research to reveal, if possible, the mechanism of observed deterioration of organic-base adhesives employed in metal-to-metal bonds in service at elevated temperatures.

The work involved a study of the performance characteristics of laboratory-formulated phenol-formaldehyde-epoxy resin adhesives that had been shown by previous work(*1*) to be one of the more heat-resistant types of adhesives for bonding metal. An attempt was made to find the possible causes of chemical and physical changes that might be associated with the deterioration of an adhesive in metal bonds in service at elevated temperatures. The thermal resistance of adhesive bonds in aluminum and stainless steel as affected by preparation of the metal surface, curing conditions, aging temperature, aging time, atmosphere during aging, and stress during aging was investigated.

300° F. in air (Figure 1-B) increased markedly in absorption from about 48 per cent transmission when precured (Figure 1-A) to 25 per cent transmission and has shifted to include absorption at 5.8 microns. The curves on Figures 1 and 2 have been smoothed out for reproduction purposes.

Aging of the postcured film for 30 minutes at 550° F. (Figure 2-A) shifted the band further, and aging the film for 16 hours at 550° F. in air (Figure 2-B) shifted the band to include absorption at 5.4 microns. The absorption in this range of infrared wave lengths (5.4 to 6.3 microns) is attributed to carbonyl groups such as are found in organic acids, anhydrides, lactones, quinones, esters, aldehydes, and ketones, or to the formation of unsaturated acetylene and ethylene groups. Some of these functional groups are possible products of oxidation and thermal degradation.

Figure 1—Infrared Absorption Spectra of Films of FPL-891


WAVE NUMBERS IN CM⁻¹
A - PRECURED 15 MINUTES AT 275° F. IN AIR
B - CURED 60 MINUTES AT 300° F. IN AIR
C - POST-CURED 16 HOURS AT 270° F. IN AIR
TRANSMISSION (PERCENT)
WAVE LENGTH IN MICRONS

Film Aging in Nitrogen

Aging of the film in nitrogen at 550° for 16 hours (Figure 2-C) instead of air (Figure 2-B) without a previous postcure in air resulted in less broadening or shifting of the absorption band in this region, indicating that oxygen from the air may have contributed significantly to the formation of various carbonyl and unsaturated groups. It was also observed that the absorption spectrum obtained when films were aged for 16 hours in nitrogen at 550° F. (Figure 2-C) was almost identical to the absorption curves obtained when films were postcured for 16 hours at 270° F. and aged for only 30 minutes at 550° F. in air (Figure 2-A).

The absorption of infrared at 3.0 microns, attributed to hydroxyl groups, showed a gradual decrease as the cure of the adhesive advanced through the cure, postcure, and aging stages. At about 3.0 microns the per cent transmission of infrared radiation was increased from 8 to 14 per cent by curing 60 minutes at 300° F., a further increase of 17 per cent by post-curing for 16 hours at 270° F., an increase to 20 per cent by aging 30 minutes at 550° F., and to 25 per cent transmission by aging 16 hours at 550° F. in air.

This increase in the transmission of infrared indicates a decrease in the number of hydroxyl groups, which could very well be related to the conversion of methylol groups in the partially cured resin to ether groups and finally to methylene crosslinkages in the cured polymer. This reaction would be expected to show a rather rapid loss in hydroxyl groups during the early stages of cure and a considerably slower rate of change with temperature and time after a high degree of cure is obtained.

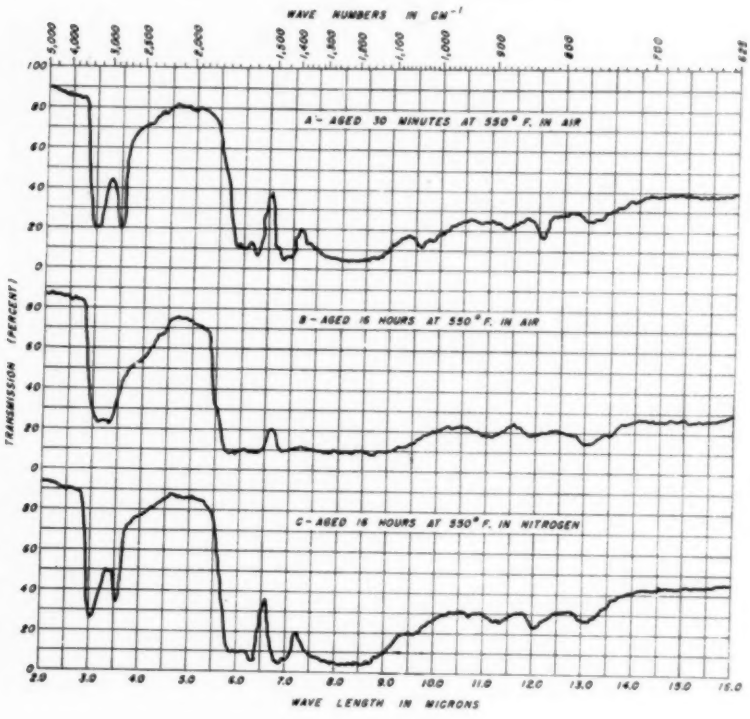
Such a correlation appears in these data in that heating for one hour at 300° F. increased the transmission in the hydroxyl region from 8 to 14 per cent, while heating for 16 hours at 550° F. beyond the 30 minutes at this temperature increased the transmission of infrared only from 20 to 25 per cent.

The absorption spectra at 3.5 microns, which is normally attributed to stretching of the carbon-hydrogen bond, showed decreases in adsorption somewhat similar to those of the hydroxyl groups as cure and heating progressed. In Figure 1 the per cent transmission in this region after precure was about 17 per cent (1-A), after cure 19 per cent (1-B), after postcure 21 per cent (1-C), after 30 minutes at 550° F. 20 per cent (2-A), and after 16 hours at 550° F. in air about 35 per cent (2-B). These values reflect a decrease in the number of carbon-hydrogen bonds as cure progresses, which might be expected to change very slowly in the initial stages of cure and postcure and then show a very rapid change after aging at 550° F. for 16 hours.

It would seem that the observed changes in the relative quantity of carbon-hydrogen groups in these tests could be correlated with the theoretical changes in the structure of phenol resin during cure and thermal degradation as described by Carswell (*2*). He has recognized that the curing reactions of phenol and formaldehyde are rapid and complex at normal curing temperatures and the extent to which the various reactions take place depends upon the structure of the intermediate phenolic compounds formed, temperature and time of the reactions, and the catalyst system. The curing reactions in Figure 3 therefore, probably represent the more simple steps in the cure of a phenolic resol resin.

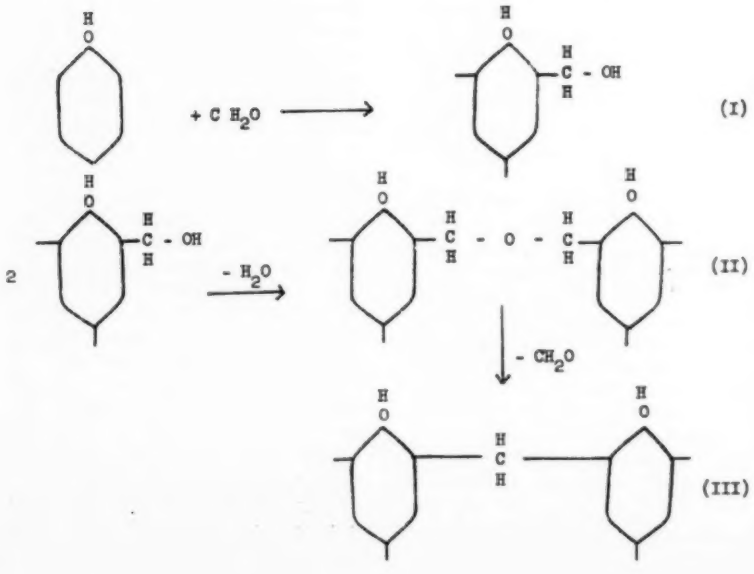
In the initial stages of cure and methylol groups of the phenol derivative (I) condense to form dibenzyl ether groups (II) without a change in the number of C-H groups. In the next step of cure the ether groups are believed to split off a molecule of formaldehyde to form a

Figure 2—Infrared Absorption Spectra of Films of FPL-891


WAVE NUMBERS IN CM⁻¹
A - AGED 30 MINUTES AT 550° F. IN AIR
B - AGED 16 HOURS AT 550° F. IN AIR
C - AGED 16 HOURS AT 550° F. IN NITROGEN
TRANSMISSION (PERCENT)
WAVE LENGTH IN MICRONS

single methylene bridge between phenol molecules (III). Hanus(*2*) reported that even under the most favorable conditions not more than 60 per cent of this theoretical amount of formaldehyde could be liberated from the system. This was attributed to the tendency of formaldehyde that was liberated momentarily to combine with methylene groups of the diphenylmethane derivative (III) and other side reactions.

Figure 3—Steps in the Cure of a Phenolic Resol Resin



Thus one would expect little change in the number of C-H groups of a resin on exposure to typical curing and postcuring conditions. The exposure of the resin to extreme temperature, such as 550° F., however, could result in thermal decomposition of the material; this may result in rupture of the methylene bridges with the formation and liberation of carbon dioxide and hydrogen. Such a mechanism has been proposed by Allen, Meharg, and Schmidt (*2*) who studied the decomposition products of phenol resin at 300° C.

Another change in the infrared absorption spectra of the phenol-epoxy resin adhesive with increased heating was the disappearance of the band at 12.1 microns, which is attributed to the para-substitution present in the original molecule of bisphenol of the epoxy resins (*3*). This band has disappeared after aging for 16 hours at 550° F. in air, showing that some thermal decomposition was also taking place within the epoxy resin. In other experiments, separate portions of one cured film of FPL-891 adhesives were aged at 550° F. between two pieces of aluminum and between two pieces of stainless steel. The aluminum surfaces had been prepared by the sulfuric acid-sodium dichromate process and the stainless steel surfaces were prepared by sulfuric acid-oxalic were prepared by the sulfuric acid-oxalic acid process (Appendix).

The pieces of metal were clamped tightly against the film to determine, if possible, any effects of the metal surfaces on changes occurring in the adhesive when heated. Changes in spectra that normally were found to occur when films were aged in air were greatly reduced when films were aged in contact with the metal surfaces. There were no noticeable differences in the films exposed next to aluminum and next to steel. The reduced amount of deterioration of these films was attributed to the exclusion of the air from the film.

Infrared studies of films of FPL-891 adhesive that also incorporated one per cent by weight of either quinolinol, copper-quinolinol, or n-propyl gallate as thermal stabilizers, showed no apparent chemical changes in films caused by the use of these materials. These materials had in previous work(*1*) shown some promise as effective agents in reducing thermal deterioration in adhesive bonds. In this study the films were aged in air at 550° F. for periods up to 16 hours.

The study of the thermal decomposition of a phenol-epoxy adhesive film by infrared absorption has shown that if the adhesive is exposed to air at elevated temperatures, the adhesive undergoes marked changes in chemical structure. These changes are apparently accelerated by the oxygen in air.

Little correlation could be found between these observed changes in adhesive films exposed to hot air and actual changes in the performance of adhesive bonds in aluminum and stainless steel that were heated for similar periods of time. The difference in performance between films and adhesive bonds of metal was presumably due to a high degree of exclusion of the air from the adhesive films in the metal joints.

2—Deterioration of metal bonds in nitrogen and air

This phase of the study was intended to study possible correlations of the chemical changes in films after exposure to high temperatures, as observed by infrared spectrophotometry, with the performance of adhesive bonds of aluminum and of stainless steel under similar conditions of heat aging. It was also hoped that the study of strength properties of metal-to-metal bonds would give an insight into the possible effects of such variables as the chemical nature of the metal surface on the thermal stability of the adhesive bond.

Unless otherwise noted, throughout this entire report the joint test specimens were 0.5 inch lap shear specimens of either 0.064 inch 24ST-3 clad aluminum alloy or of 0.020 inch thick T302, ½ hard stainless steel. Aluminum specimens were bonded in panel form and then cut carefully into individual specimens, each one inch wide. Because of the difficulty of sawing individual specimens of stainless steel from panels after bonding without damaging the bonds, a different procedure was used here.

In the earlier work, steel sheets for multiple panel bonds were slit down from one edge before bonding so that all that was required to separate bonded specimens for test was to cut away a short strip at the ends of the specimen. In later studies, individual stainless steel coupons were bonded directly with a suitable jig to maintain alinement.

For the investigation of the deterioration of bonds in nitrogen and in air, the aluminum and stainless steel lap joints were bonded with the same batch of FPL-891 adhesive as was used in the study of films by infrared absorption. The surfaces of the aluminum and steel were prepared for bonding by first wiping the metal surfaces with a clean cloth saturated with ethyl acetate. The aluminum was then treated chemically by Method A (Appendix) and the steel by Method B (Appendix).

The adhesive was brush spread on the treated metal surfaces on the same day as the metal was prepared and the coated surfaces precured for 15 minutes at 270° F. The metal panels were then assembled and pressed at 50 pounds per square inch for one hour at 300° F. and postcured for 16 hours in air at 270° F. without external pressure. The panels were cut into specimens one inch wide; the specimens were then selected by the randomized block method for each of the test conditions.

The shear strength of the lap-joint specimens was determined by loading at a rate of 1200 to 1400 pounds per square inch per minute (the method described in Military Specification MIL-A-8331 [USAF]: Adhesive, Aircraft Structural, Metal-to-Metal, June 26, 1953). The bonded lap joints were tested in shear at room temperature after the postcure of 16 hours at 270° F. to obtain the initial shear strength of the bonds for control purposes; other representative groups of ten specimens each were set aside for exposure in air and in nitrogen at 550° F. before cooling and testing at room temperature.

The lap joints to be aged in nitrogen were placed in a tight metal cylinder; a slight pressure of nitrogen was applied to exhaust the chamber of air and volatile byproducts and to provide an atmosphere of an inert gas. The nitrogen was passed through sulfuric acid drying trains before being introduced into the chamber.

The results of tests at room temperature of lap joints of aluminum and stainless steel after aging for various periods at 550° F. in air and nitrogen are shown in Table I.

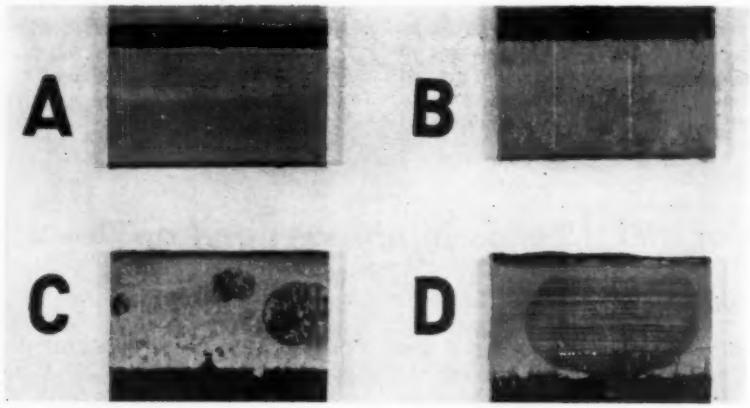
The results of these tests showed conclusively that the type of metal,

Table I—Effects of Aging at 550° F. on Lap Shear Specimens of Clad Aluminum and Stainless Steel Bonded with FPL-891

Hours of exposure at 550° F.	*Atmosphere*	*Metal*	*Shear Strength at 80° F.*			
			Method A—Surface Treatment		*Method B—Surface Treatment*	
			P. s. i.	*Percent**	*P. s. i.*	*Percent**
0		Aluminum	1,312	38-0	878	96-0
96	Air	Aluminum	688	85-3	244	90-79
200	Air	Aluminum	624	85-15		
96	Nitrogen	Aluminum	784	80-6	320	90-31
200	Nitrogen	Aluminum	796	73-12		
0		Stainless steel	434	100-0	2,018	7-0
96	Air	Stainless steel	0	100-100	44	100-100
200	Air	Stainless steel	0	100-100		
96	Nitrogen	Stainless steel	62	100-56	578	21-81
200	Nitrogen	Stainless steel	26	100-92		

Note: The first value is the average percentage of bond area which has failed in adhesion to metal. Each value is the average of 10 specimens. The second value is the average percentage of estimated area in the bond showing evidence of discoloration or thermal degradation.

Figure 4—Bond Areas of Aluminum Specimens Aged at 550°F.



A—No deterioration, high joint strength. B—Branched tunnel-like voids, little deterioration, high joint strength. C—Small spot-type deterioration, intermediate joint strength. D—Large spot type deterioration, low joint strength.

method of metal surface preparation, and the atmosphere of exposure had marked effects on both the initial strengths of the bonds and also on the strengths of bonds after aging at the elevated temperature.

The performance of bonds of aluminum showed that the initial strength of bonds before aging was greatly affected by the treatment of the surface prior to bonding. An oxidizing chromate solution (Method A), which could presumably produce an aluminum oxide layer on the bonding surface, gave much higher initial strengths before heat aging than did a reducing treatment (Method B), which might presumably remove the naturally occurring aluminum oxides from the bonding surface.

The aluminum joints prepared by Method A, although higher in strength after aging for 96 hours in air than the bonds prepared by Method B, were reduced in strength approximately the same amount from the initial strength values. This would indicate that the strength of bonds after aging at elevated temperatures is closely related to the initial bond strength and to the bonding characteristics of the metal surface.

The data on aluminum specimens showed that the principal reduction in joint strength due to aging occurred within the first 96 hours of exposure and further aging up to 200 hours had very little effect, if any, on joint strength. The fact that there were no important progressive losses of strength of the aluminum specimens in heat aging beyond 96 hours in either air or nitrogen, and that there was very little severe charring or discoloration in the bonds after these tests, suggests that the losses of joint strength during the first 96 hours of aging may more likely have been due to further cure and embrittlement of the adhesive rather than to actual thermal deterioration of the phenol-epoxy resin adhesive.

This lower level of strength noted here after heat aging, has also been noted previously with this type of adhesive when bonds were cured initially at higher temperatures, such as 350° F., a condition assumed to cause embrittlement and internal strains due to a high degree of cure without actual polymer degradation. The color of the bonded areas after test also indicated that 200 hours aging at 550° F. in a bond was considerably less severe in discoloration and possible thermal degradation than aging, in the film form, for 16 hours at 550° F. in air or nitrogen as was done in the study of unsupported adhesive films by infrared absorption.

The bonded areas of the aluminum specimens after heat exposure and test were examined microscopically. Within a typical bond area a network of minute tunnel-like voids were visible that extended in from a bubble in the squeezeout at the edge of the joint toward the center of the bonded area (Figure 4). The minute tunnels were apparently formed by the loss of volatile materials during the bonding process, as they were visible in both aged and unaged specimens.

Discoloration of the adhesive film by heat aging was evident along the walls of the tunnels, but it extended back into the adhesive mass only a very short distance; this depth of penetration was not noticeably increased as the exposure period was increased from 96 to 200 hours. In other work on a similar type of adhesive, discoloration in the tunnel

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walls has been observed after only four hours aging at 550° F. but without appreciable increase in depth by extending the exposure to 200 hours. The discoloration and thermal decomposition of the adhesive in these areas was believed to have been caused by residual volatiles consisting probably of solvent, ammonia, water, formaldehyde, and phenol, that were volatilized during cure but remained in the tunnels.

The evidence thus indicated that there should be little thermal deterioration of FPL-891 phenol-epoxy resin adhesive in bonds of aluminum at 550° F. after 200 hours if the metal surface has been prepared properly and certain undesirable volatiles are removed.

The performance of FPL-891 adhesive, aged at 550° F. in bonds of stainless steel, differed in many respects from that in bonds of aluminum. The data in Table I showed that in addition to the type of surface preparation, the atmosphere of exposure was highly important in affecting the thermal resistance of the adhesive bonds. For stainless steel the sulfuric acid-oxalic acid method of surface treatment gave better initial bond strength and better thermal resistance properties than the sulfuric acid-sodium dichromate process. The reverse was true for bonding of aluminum. This would indicate that for aluminum FPL-891 bonds best to an oxidized surface, and for stainless steel it bonds best to a reduced surface.

The presence of air during the aging cycle obviously contributed to the breakdown of the adhesive in stainless steel bonds. Examination of the stainless bonds after heat aging and testing showed that discoloration of the adhesive started at the edges of the lap joint and progressed inward as longer aging periods were employed. The rate of discoloration was much lower when bonds were aged at 550° F. in nitrogen, and higher joint strengths were retained, particularly when Method B was used in preparing the metal.

The generally inferior performance of stainless steel bonds on heat aging compared to that of aluminum bonds might be evidence that the metal itself contributes to degradation of the adhesive. It is possible that oxides of iron, nickel, or chromium are formed in the surface layers of the steel during heat aging of the bonds and may act as catalysts for the subsequent deterioration of the adhesive in contact with these metal surfaces. The progressive discoloration of the adhesive inward from the edges of the steel bond might be interpreted as further evidence of the adverse effect of the stainless steel surfaces inasmuch as a similar progressive type of breakdown of the adhesive was not observed on aluminum. These hypotheses served as a basis for much of the later work reported on in this study.

APPENDIX

Adhesive Formulations

FPL-891 Adhesive

Phenol resin (Durez 16227)	12.5 grams
Epoxy resin (Epon 1001)	2.0 grams
Ethyl acetate	2.0 grams

This formulation was thinned with an equal weight of ethyl acetate before spreading.

FPL-878 Adhesive

Phenol resin (Durez, 16227)	12.5 grams
Phenol resin (Bakelite BV9700)	3.3 grams
Epoxy resin (Epon 1007)	2.0 grams
Ethyl acetate	2.0 grams
n-propylgallate	0.2 grams
1-hydroxy, 2-naphthoic acid	0.2 grams

This formulation was thinned with an equal weight of ethyl acetate before spreading.

Methods of Preparing Metal Surfaces for Bonding

Method A

Immersion for 5 minutes at 150° F. in a solution of:

Sulfuric acid (conc.)	100 grams
Sodium dichromate	10 grams
Water	300 grams

Rinse in cold tap water, then in distilled water, and air dry.

Method B

Immersion for 10 minutes at 190° F. in a solution of:

Sulfuric acid (conc.)	100 grams
Oxalic acid	100 grams
Water	800 grams

Rinse in cold tap water, then in steam, and air dry.

Method C

Immersion for 5 minutes at 140° F. in a solution of:

Sulfuric acid (conc.)	100 milliliters
Hydrofluoric acid (50 percent)	150 milliliters
Water	250 milliliters

Rinse in cold tap water, then in distilled water, and air dry.

Method D

Immersion for 10 minutes at 150° F. in a solution of:

Hydrochloric acid (conc.)	100 grams
Hydrogen peroxide (30 percent)	4 grams
Formalin (40 percent)	20 grams
Water	90 grams

Rinse in cold tap water, then in distilled water, and air dry.

Method E

Immersion for 15 minutes at 170° F. to 180° F. in a solution of:

Sulfuric acid (conc.)	100 grams
Sodium dichromate	10 grams
Water	55 grams

Rinse in cold tap water, then distilled water, and air dry.

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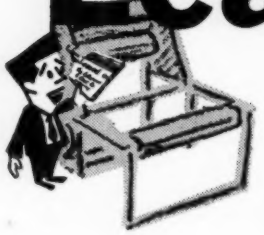
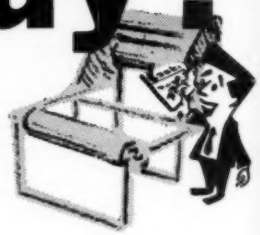
To Be Continued Next Month . . .

Lease or Buy?





No method of financing fits every situation equally well. The adhesives manufacturer or user planning the acquisition of new production equipment must, therefore, closely study the factors of his own particular case before deciding whether to lease or buy. Expert advice never hurts, and the following series of questions and answers was devised to highlight some of the considerations bearing on that decision.

By ROBERT SHERIDAN
President
Nationwide Leasing Company
Chicago 3, Illinois

What is the volume of equipment leasing in the adhesives industry?

At the end of December, 1958, there was approximately $1.5 million worth of production equipment on long-term lease to manufacturers of adhesives. This represents about 8 per cent of the total dollar volume of equipment on lease to the chemical industry as a whole. Most leasing to the adhesives industry has occurred in the past three years, more than half the total during 1958.

In December, 1958, there was approximately $227 million worth of production equipemnt on long-term lease throughout U. S. industry. Major reasons for the growth of leasing among manufacturers are: (1) to preserve working capital while expanding capacity, (2) to acquire equipment used in research and development work and (3) to offset the increasing cost of equipment. The healthy rate of profit earned on net working capital—an industry average of 47 per cent *before taxes*—provides a strong reason for keeping liquid capital working in the business.

What is equipment leasing?

Equipment leasing is a method of obtaining the use of income-producing equipment (fixed assets) without capital investment. Equipment obtained in this way remains the property of the leasing company, but is used by the lessee, who pays the leasing company a fixed charge for a stated period. Leases are usually written on a uniform payment basis although they can be written on straight line, declining balance, sum of digits, or any schedule preferred by the user.

Leasing is a long-term arrangement—normally from three to ten years. It is different from equipment *rental* which is a short-term affair. In the latter case, new or used pieces are rented out for a brief period by a firm which afterwards reclaims and rents the equipment to other users.

How does equipment leasing work?

A company desiring to lease equipment from a rental firm submits an application describing its business, its financial position, etc. It lists the specific manufacturer from whom it wishes to secure the equipment, the price of the equipment, the length of the lease terms and the form of payment it desires. The leasing company then purchases the equipment and arranges for its shipment directly to the lessee's plant or store. Payments start upon acceptance of the equipment.

All equipment, no matter how items or suppliers are involved, can be covered by a single master lease and can be paid for in a single monthly payment. This reduces the user's bookkeeping considerably.

What types of equipment are leased?

All types. In 1958, equipment leased ranged in cost from a $17 hand truck (part of a $140,000 equipment lease with a midwestern hospital) to $5,000,000 worth of construction equipment. Both standard and specially-built units can be leased.

Why has equipment leasing increased so rapidly?

Basically, equipment leasing has increased as a result of the steadily increasing cost of capital equipment. Leasing has historically been a means of permitting businessmen to function without owning everything they need to do business, since profits are made by *using* capital equipment, rather than *owning* it. Specific reasons for the current growth of equipment leasing are:

(1) Profit-producing equipment is put to work without capital investment.

(2) To increase profits and production without increasing a company's investment and reducing liquid working capital.

(3) To reduce the risk of loss caused by rapid obsolescence of specialized equipment.

(4) To obtain equipment for limited-term use, either for special orders or for development or research work.

(5) For manufacturers of industrial equipment leasing programs have proved to be an effective method of increasing sales.

What are the advantages of leasing?

Other advantages to users of leased equipment, in addition to those cited above lie in how leasing improves a company's financial situation.

(1) Leasing offers financing without dilution of ownership or control.

(2) In leasing, there is no necessity for a periodic cleanup of funds or a pledge of receivables.

(3) Leasing may offer certain tax-timing advantages in specific instances.

(4) Leasing makes for a cleaner balance sheet. Only the lease payments due within 12 months appear on the balance sheet, thus affecting the ratio of current assets to current debt very little. As a result, a company is able to use its established

lines of credit for short-term borrowing without disturbance.

What types of companies lease equipment?

All types of companies in virtually every industry today lease equipment. They range in size from quite small companies to giant companies in the billion-dollar-a-year sales category. According to annual surveys, the ten leading industries using leased equipment in 1958 were aircraft and parts; chemicals and drugs; construction and road building; electrical equipment and machinery; fabricated metal products; food products; petroleum refining; printing and publishing; pulp, paper, and allied products; the supermarket industry.

Is equipment leasing useful as a sales tool for manufacturers of production equipment?

In a number of industries, leasing programs have proved to be an effective method of increasing sales, through offering customers the option of purchase or lease—with the leasing company assuming the lease contract and paying the manufacturer 100 per cent cash for the equipment when the equipment is delivered. The leasing company sets up a complete sales training program for the manufacturer so that his leasing plan will have maximum impact.

How does leasing compare with other methods of financing?

Leasing offers 100 per cent financing and provides the adhesives manufacturer with greater cash flow than any other financing method. As a result, the relative cost of leasing is less. Any expenditure of money to acquire equipment involves paying something for the use of the money. In the case of outright cash purchase, the manufacturer "pays" by sacrificing the earnings that his working cash would yield. This, in effect, is what he is "paying" for the use of his own money.

A complete analysis of the comparative cost of leasing and other financing methods, entitled, "Lease or Buy? Comparative Costs of Equipment Acquisition," has been developed by the Foundation for Management Research. Single free copies may be obtained by writing to the Foundation at 121 West Adams Street, Chicago 3, Illinois.

What are recent trends in leasing?

Two new trends have shown themselves: (1) the sale-leaseback transaction (commonly, but erroneously, termed purchase-leaseback) and (2) merchandising-leasing plans involving the cooperation of equipment manufacturers and a leasing company to increase sales.

In the sale-leaseback transaction, a company builds a new plant, sells the equipment and facilities to the leasing company as soon as it is completed and ready for use, and immediately leases it back. *Often this is done with older plants also.* This enables firms whose financial ratios would not otherwise permit them to expand at so great a rate, to do so without straining their capital structure.

What operating situation make leasing most advantageous?

(1) In general, where companies can expand their operations profitably, if additional equipment and machinery were made available at smaller annual expense than through use of their own capital.

(2) Companies which find themselves short of working capital but which have sufficient equipment, can remedy the situation through sale-leaseback transactions.

(3) Companies faced with competition that is using the latest equipment, while they themselves lag on cost-saving because the initial switch-over cost is prohibitive.

(4) Companies which hold a tight check rein on capital expenditures and financial ratios.

(5) Where rapid obsolescence is a strong possibility.

(6) For pilot plants, developmental or experimental projects.

(7) Companies engaged in contract work can obtain needed equipment for the term of the contract.

Do leasing agreements contain purchase options?

Yes, leasing agreements can contain purchase options. However, a purchase option generally converts a leasing agreement into a conditional sales contract, in the eyes of the Internal Revenue Department. Exceptions to this rule are uncertain and depend on specific rulings by the Internal Revenue Department at the conclusion of the contract, many years later. True lease payments are legitimate deductions as operating expenses.

Do leasing contracts contain renewal options?

In leasing, the cost of the equipment is paid for entirely in the original leasing term. Renewal options are usually available at extermely low cost.

Does leasing offer companies tax advantages?

This has been an area of much misinformation. Leasing is not a method of tax avoidance; its primary value lies in the way it frees working capital for other uses. In certain situations leasing may also offer companies advantages of tax-timing which are not to be ignored. Leasing charges are legitimately deductible as business expenses. As such, they reduce taxable income *now*.

Leasing may also offer a tax advantage that can be of particular importance to companies which find that their equipment tends to become obsolete much more quickly than government depreciation tables permit.

For example, a company using equipment that experience shows it can expect to have to replace in seven years, may find that depreciation tables permit depreciation only over 15 years. By leasing this equipment for a seven-year period, this company would be able to deduct the full cost of the equipment from taxable income in seven years. If the company had purchased the equipment, it would only have used seven years worth of depreciation and would have to forego further depreciation benefits, if it wished to replace the equipment at the end of seven years.

In certain sale-leaseback situations also, tax advantages may accrue, since the sale of an asset normally involves taxation at the capital gains rate, if a profit is made, rather than at the corporate rate.

About the Author . . .

ROBERT SHERIDAN received his engineering degree from Cooper Union Institute, New York City, and did graduate work in business administration at Northeastern University, Boston, and the University of Chicago. He founded Nationwide Leasing Co. in 1957.

NEWS of the

ADHESIVES WORLD

B.R.I. Holds 8th Annual Meeting

Over 600 persons attend Technical Sessions on April 7-8 in Pittsburgh

Over 600 persons attended the 8th Annual Meeting of the Building Research Institute at the Penn-Sheraton Hotel, Pittsburgh, Penna., on April 7-8. The technical program consisted of concurrent sessions on Sealants for Curtain Walls, Workshop on Windows, and Mechanical Fasteners in Building. The Annual Meeting was called to order by Robert W. McKinley, Technical Representative, Pittsburgh Plate Glass Co., who served as meeting chairman. He introduced the opening session speakers, Charles H. Topping, BRI president; Robert W. Dowling, president, City Investing Co.; Burnham Kelly, associate professor of city planning, Massachusetts Institute of Technology; and Vincent G. Kling, architect.

Mr. Topping discussed the 1958 Annual Report of the BRI, and was followed by Mr. Dowling who spoke on "The Investor's Attitude toward City Planning and Building Design of the Future." He remarked that everybody associated with building and building trades should give serious thought to the type and kind of buildings we will have to occupy in the future, and who will occupy these buildings and for what purpose.

The next speaker was Prof. Kelly, whose subject was "The Home Building Industry of the Future." He pointed out that the most important thing about the housing industry in the 1960's is that it will actually become an industry. He stated that the forces that will bring about this change have long been storing up, and in specialized aspects of the industry—trailers, prefabs and the appliance business—it is already possible to see indications of the shape of things to come.

"A Designer's View of Building of the Future," was Mr. Kling's topic. He stated that this post-war period has witnessed the rise of modern architecture as a popular style. It is marked by a new consciousness of interior space as an entity and a growing mastery over the variables that govern our reactions to interior space. He pointed out that it is the typical enclosure of this space that has provided the most vivid symbol of the post-war era—the curtain wall with its grids of glass and metal. What began as a restful sight for sore eyes has, by the process of endless multiplication, become a new kind of eyesore.

The weapons to combat this will be new structural forms and working closures aimed at restoring the third dimension to architecture and achieving more natural lines. According to Mr. Kling, we shall see a greater use of tension rings; hyperbolic paraboloids, thin-shell concrete pre-cast, pre-stressed and post-stressed concrete; geodesic domes and laminated timber. All these systems and methods will produce new challenges to engineering ingenuity and to understanding of interior and exterior space, he stated.

Wayne F. Koppes, architectural consultant, served as chairman of the first day's session on Sealants for Curtain Walls, which was attended by over 300 persons. The first part of the program consisted of talks by J. M. Roehm, director of research and development, Kawneer Co.; E. R. McLaughlin, associate professor of engineering research, Pennsylvania State College; Walter J. Engert, chief designer, General Bronze Corp.; and Francis L. Frybergh, associate partner of Skidmore, Owings & Merrill.

Mr. Roehm spoke on the "Current Status of Sealants for Curtain Walls." The purpose of his talk was to set the stage for the speakers and to give some general orientation on the entire subject. He discussed the history and advances made in curtain walls and the problems of properly sealing metal curtain walls.

Prof. McLaughlin's topic was "Performance Testing of Curtain Walls." He stated that as soon as the

Wayne F. Koppes (extreme right), chairman of the opening session on Sealants for Curtain Walls at the BRI meeting, making his opening remarks. Seated at the table are the first group of speakers. They are (left to right) Walter J. Engert, E. R. McLaughlin, Francis L. Frybergh and J. M. Roehm.

exterior wall for a building is set up many forces start working to tear it down. He explained that to help evaluate the performance of new materials in curtain wall panels a series of tests have been developed to stress the panel at least as much as it is likely to be stressed in service. In some exposures there is a degree of acceleration to speed up the appearance of short comings if they are to develop, he said.

"Dynamic Testing Procedure" was the subject covered by Mr. Engert, who said that to aid the architect, contractor, engineer and owner in the preparation of rigid specifications, there is an endeavor to set forth the procedure and principle of weather testing architectural products, primarily applicable to windows and modern curtain wall construction. These tests provide static and dynamic conditions of air pressure, due to winds, in order to measure unit infiltration of air and water from wind driven rains, he stated. He pointed out that in the interest of maintaining high standards and in a constant endeavor to improve products, all new designs should be subjected to exhaustive weather tests.

Cites Testing Methods

The final speaker, Mr. Frybergh, discussed the "Correlation, Consolidation and Improvement of Testing Methods." He stated that in multistory structures particularly, failures in sealants or sealing methods which become apparent during tests allow for minor changes prior to the beginning or erection at the site without any addition in costs. Corrections after erection may be very costly considering the inaccessibility of sealants and gaskets in the completed wall. He pointed out that the erection of test panels and subsequent tests give the curtain wall erector, the glazing contractor and the architect the opportunity to evaluate the specified materials and methods of sealing.

The Sealants for Curtain Walls session at the 8th Annual Meeting of the Building Research Institute was attended by over 300 persons. The session was held in the Grand Ballroom of the Penn-Sheraton Hotel in Pittsburgh, Pennsylvania.

The last half of the day's program was devoted to talks on user's problems with curtain wall sealants and a panel discussion. The speakers were Harold H. Charles, project director, Reynolds Metal Co.; Woodie Garber, Garber & Associates; George Grenadier, president, Grenadier Corp.; and R. G. Whittemore, director of Product Development Department, Pittsburgh Plate Glass Co. The panelists were George R. Harris, chief chemist, Johnson Rubber Co.; Boris W. Pozniak, technical director, Pecora Paint Co.; Joseph Amstock, chief chemist, Products Research Co.; A. G. Storms, sales representative, Industrial Rubber Goods Co.; Leslie Jackson, Tremco Manufacturing Co.; Samuel H. Krumholtz, sales manager, General Mastics Corp.; and T. O. Mathues, chief engineer, Inland Manufacturing Division, General Motors Corp.

Speaking from the fabricator's viewpoint, Mr. Charles stated that such a viewpoint on sealants and sealing may better be termed as one man's opinion. He noted that the areas of general concern and source of trouble to most fabricators using sealants are cost of material and labor, workmanship, performance and useful life, and division of responsibility. He stressed the fact that the fabricator, who is not a chemist, finds it difficult to keep pace with the changing limits and characteristics of sealants. However, this is progress and is good for the industry. He mentioned it because of the need and importance for recognizing individual limitations, seeking technical information, and maintaining liaison with sealant manufacturers.

Mr. Garber, discussing the user's problems from the architect's standpoint, noted that the architect, as a user of sealants in curtain walls, shares the problems of the owner and the other users in both completed installations and work in progress. Because of the architect's constant anticipation of new and better architectural solutions to building needs, however, his search is often beyond the scope of presently available systems and solution. He stated that the development of sealants and their extended uses, so responsible for the present attainable success of our vertical partial envelopes, must accelerate and broaden to provide solution for the multiplying imponderables of the total envelope that lies immediately ahead.

Mr. Grenadier, speaking for the applicators, stated that there has been a lack of coordination on the job itself since the applicator very frequently battles other trades in an effort to prevent them from disturbing or touching the sealant prior to cure. Often it is a question of the

Panelists and speakers, who discussed the users' problems with curtain wall sealants at the Sealants for Curtain Walls session of the BRI meeting, listen to Woodie Garber (extreme right) give the architect's viewpoint on sealants.

general contractor's attitude on the job as to how it is to be applied, where it is to be applied, and under what conditions it is to be applied. He said that one of the basic things on a job is to make a proper diagnosis. Both contractor and architect must work together from the very outset. He stated that there should not be a division of responsibility on a specific job in order to assure that the job itself is guaranteed properly. Citing an example, he said in the case of a curtain wall structure, the fabricator should control the polysulfide sealant through his sealant contractor. The fabricator, in addition, should also handle the glass, and under him, the glazing subcontractor.

Speaking from the viewpoint of the glass manufacturer, Mr. Whittemore stated that adhesion to glass by other materials is a problem of major proportions. He explained that glass is non-absorbent; has a high polish; its heat capacity is great enough to cause condensation when ambient air conditions change rapidly; and the exact physical or chemical nature of its surface is not wholly understood under varying conditions of humidity and solarization, including ultra-violet radiations.

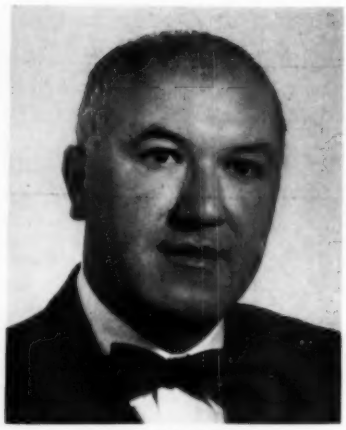
The panel and audience then discussed the speakers' remarks, covering such issues as: What is being done to determine a specification for curtain wall sealants?; Can the applicator expect help on the job from the sealant manufacturer?; What is being done in coloring of tapes?; and What about a one-part polysulfide?

New Developments

The second day's session dealt with new developments in materials and techniques. Clayton S. Myers, project manager, New Product Market Development Department, Union Carbide Plastics Co., served as chairman of the meeting which included talks by James F. Wernersbach, marketing coordinator, Enjay Co., whose subject was "Butyl Sealing Materials"; P. S. Sussenbach, Presstite Division, American Marietta Co., "Polybutane Sealing Materials"; George J. Schulte, product manager, Adhesives, Coatings & Sealers Division, Minnesota Mining & Manufacturing Co., "Polysulphide Sealing Materials"; John W. Winkler, vice-president, Coast Pro-Seal & Manufacturing Co., "Polyurethane Calking Materials."

Also H. M. Johnson, product manager, Rubber Silicones Division, Union Carbide Corp., "Silicone Sealing Materials"; Robert H. Barton, technical representative, E. I. du Pont de Nemours & Co., Inc., "Neoprene Gaskets"; George S. Page, manager, Architectural Division, Pawling Rubber Co., "Preformed Gaskets"; John Dinkeloo, partner, Eero Saarinen & Associates, "Structural Gaskets"; and Robert Bostwick, chemist, Union Carbide Plastics Co., "Sealing Pre-Cast Units." A question-and-answer period, moderated by J. M. Roehm (Kawneer), followed the talks and closed the two-day meeting on sealants for curtain walls.

The BRI meeting was brought to a close after talks were given on research plans for the '60's and their effect on 1970's buildings. The final gathering was under the chairmanship of Dr. G. A. Webb, director of administration, Mellon Institute, and the speakers were Dr. J. E. Archer, director of research, Pittsburgh Plate Glass Co.; Dr. J. B. Austin, administrative vice-president, research and technology, U. S. Steel Corp.; Dr. Paul W. Bachman, vice-president and director of research, Aluminum Company of America; E C. Hartman, assistant director of research, Aluminum Company of America; Dr. S. W. Herwald, vice-president of research, Westinghouse Electric Corp.; and Dr. Lawrence C. Hicks, director, Research and Development Laboratories, Allegheny Ludlum Steel Corp. A question-and-answer period preceded final adjournment.



Judson W. Arnold

Named By Shawinigan

Judson W. Arnold has been appointed to the newly created post of director of development for Shawinigan Resins Corp., Springfield, Mass. Mr. Arnold formerly was general manager of the company's Gelvatex Division, Anaheim, Calif. The company also announced the appointment of Donald A. Gendron to succeed Mr. Arnold as division general manager. Mr. Arnold holds a B.S degree in chemistry from the University of New Brunswick. Prior to joining Shawinigan's Gelvatex Division in 1956, he was technical director of the Sherwin-Williams Co. of Canada, Ltd., for eight years. Mr. Gendron, a graduate of Manhattan College, joined the division in 1957. He formerly was sales manager for National Paint and Varnish Co., Los Angeles, Calif.

TAPPI Testing Meeting

Technical Association of the Pulp and Paper Industry has announced that its 10th Testing Conference will be held at the Multnomah Hotel in Portland, Ore. on August 17-21. The conference will include two days of technical sessions, visits to local pulp and paper mills, testing committee meetings and a logging trip. A special feature of the conference will be a panel discussion on pulp evaluation. Roy P. Whitney (Institute of Paper Chemistry) will be moderator of this discussion, which will feature a group of recognized authorities in the field of pulp evaluation. Curtis M. Walseth (Weyerhaeuser Timber) is general chairman of the meeting, and the technical program is being arranged by S. M. Chapman (Pulp & Paper Research Institute of Canada). A small exhibit of testing instruments is planned in connection with the meeting under the chairmanship of Fred Bachelder (Testing Machines, Inc.).

Oops . . .

Williamson

Kraus

In our April issue, the photos of D. G. Williamson, author of "Adhesives and Equipment for Glue Lap Corrugated Containers," and Herbert S. Kraus, author of "Epoxy Bonding of Aircraft Structures," were unintentionally switched. The correctly captioned photographs appear above.

National Starch To Change Name

National Starch Products Inc. has announced plans to change its corporate name to National Starch and Chemical Corp., effective May 8. The proposed change is said to reflect the increased importance of chemical products and processes in the company's business. In announcing the proposed change, the company emphasized that it means no lessening of its activities as a leading producer of adhesives, starch products and specialties for the packaging, paper, textile and other fields.

The company claims that as a result of its research and development work dating back to the 1930's, it is today one of the two largest producers of vinyl acetate polymers and coploymers in emulsion form for the adhesive, packaging, paper, textile, paint and other industries. The company reports that a substantial part of its present sales are in chemical products, and many of its adhesive, starch and other manufacturing operations involve chemical processes. The change in name will reflect more accurately its present interests which, in addition to starch and adhesives, include synthetic resins, the company states.

Copolymer Available

Antara Chemicals Division, General Aniline & Film Corp., New York, N.Y., has developed a new vinylpyrrolidone/vinyl acetate copolymer in solid form which is reported to be unique in its film-forming and adhesive properties, broad solubility range and exceptional compatibility characteristics. Known as PVP/VA S-630, the new copolymer offers special advantages to manufacturers of adhesives including pressure-sensitive and water-rewettable types, inks, paper coatings, flexible finishes, sizes for glass fibers, protective coatings and cosmetics, the company states.

Establishes New Site

General Mastics, Inc., producer of resinous mastic, has moved its plant and offices from Chicago, Ill., to 275 North Forge St., Akron, Ohio. It will be operated as a subsidiary of the Lustro-Plastic Tile Co. The firm, established in 1950 by Nina Himmelright, manufactures resinous mastic, which is used to hold plastic tiles to walls and floors.

Thomas W. Morningstar

Mark P. Malkovich

Morningstar Forms New Department

A new Gum and Technical Products Department, which will unify the operations of two previously distinct groups, has been formed by Morningstar-Paisley, Inc., New York, N. Y. The consolidation of the Technical Products Department with the Water-Soluble Gum Department is designed to provide expanded sales and technical service to processors and manufacturers who use gums, starches and other specialty items for stabilizing, thickening, binding, gelling, sizing, coating, flocculating, encapsulating, etc.

The new department will coordinate all technical activities dealing with gums and other specialties from the customer service standpoint at both the product development and product application levels. Morningstar's service position in the water-soluble gum field was strengthened recently by the acquisition of Thurston & Braidich, importer and processor, and the establishment of a gum processing plant in Hawthorne, N. J.

Thomas W. Morningstar has been named general manager of the new department, and Mark P. Malkovich, who has been specializing in product development, has been appointed sales manager. Mr. Malkovich brings to his new position a wide background of experience in sales and technical applications. He was graduated from Columbia University and is a member of SAACI and the Canadian Institute of Mining and Metallurgy. His prior associations were with Arnold, Hoffman & Co., Inc., and J. B. Henriques, Inc., New York, N. Y., and General Mills, Inc., Minneapolis, Minn.

The company has also appointed Miss Kay Colton as manager of cosmetic sales for the department, while John Birrell will continue as manager of corrugating sales. Thurston & Braidich personnel who have been incorporated into the new department include Charles Rosevear, Jr., administrative; Charles M. Ferri, technical-field service; and George Gilbert and James Sullivan, field sales. Other key members of the department in sales assignments are John J. Quinn and Robin T. Hazell, Morningstar's Canadian sales and service representatives with offices in Toronto, Ont.

Transmar Bonding Cement

Transmar, Inc., Chicago, Ill., has developed a crystal clear, odorless all-purpose bonding cement which is said to bond cork-board, cork tiles and fiberglass to fiberglass; fiberglass tape to fiberglass; fiberglass to metal; plastic to plastic; and plastics to non-plastics. According to the company, the cement can be brushed on smoothly and quickly, leaves no lumps and makes a smooth finished job. Fast drying, it has excellent coverage and remains flexible. Its mild solvents are especially formulated not to affect the thinnest plastics.

HOW MANY MARKETS* FOR INDUSTRIAL ADHESIVES CAN YOU SEE IN THIS PICTURE?

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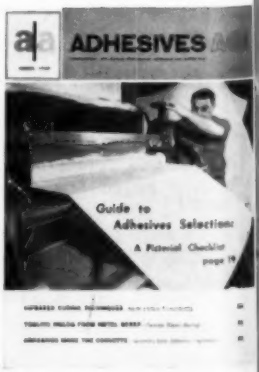

The photo shows 10 markets: luggage, footwear, clothing, aircraft, tires, plywood truck bodies, tapes, labels, cartons, hats. But this is only part of the story. For example, in a single plane today, there are at least 800 pounds of 12 to 15 different types of adhesives.

MORE
THAN MEETS THE EYE

THE ten applications spotted in the advertisement on the left merely cover the obvious adhesives uses . . . you probably can name scores of others.

INSIDE the plane, for example: floor coverings, furniture, emergency life-saving gear. A dozen or so uses on the instrument panel . . . more in the radio compartment. The number of different industries seems endless.

STEP into the terminal and countless other adhesives markets come into view. Baggage conveyors, platforms, desks, counters, fixtures and flooring are just a few. And how many in the cab—car—bus—or train you take home?

WHETHER you can *see* each adhesive market or not, you can *sell* them *all* in ADHESIVES AGE. For A/A alone serves the men who buy adhesives, materials, machinery, equipment, supplies and services for thousands of companies that use, make, ship, store and apply adhesives.

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Wyandotte Sales Up

Wyandotte Chemicals Corp., Wyandotte, Mich., has reported 1958 sales of $82,116,603, second best in its history, and earnings from operations of $2,902,642. Comparable figures for 1957 were $85,028,009 and $4,775,157. The 1958 earnings were the equivalent, after provision for $522,644 dividends on preferred shares, of $1.67 on the 1,422,873 common shares. This compared with $2.98 on 1,421,563 common shares outstanding at the end of 1957 and preferred dividends of $533,475. The sharp business recession and new plant start-up costs resulting from the $40,000,000 expansion in facilities undertaken by the company in 1957-1959, adversely affected earnings, but recovery in business began in the third quarter and the virtual completion of the current expansion program is expected to prove to be of major benefit through a substantially broadened base of manufacture and sales.

Anti-Skid Paper

Hollingsworth & Whitney Division of Scott Paper Co., Chester, Penna., has developed a new type of anti-skid paper which is reported to give maximum protection against slippage of multiwall bags during transit or storage. The company reports that the anti-skid paper, called Gripper-Kraft, is applicable to a wide variety of packaging uses in the chemical, food, fertilizer, mining, cement and other industries where damage to bags during shipment or storage in warehouses is a major problem. Some of the specific products suggested by the company for packaging in multiwall bags made of Gripper-Kraft include dry adhesives, sugar, feed, fertilizer, mineral and mining products, starch, salt and milk in powdered form.

Plastic-Lead Putty

Devcon Corp., Danvers, Mass., has developed a putty like lead material made up of 94 per cent lead and 6 per cent plastic that can be formed into any shape without heat or pressure. According to the company, the material, called Devcon L, has high impact, compression and tensile strength, and exhibits excellent resistance against most solvents, acids, and other chemicals. It bonds lead, steel, aluminum, bronze, brass, wood, iron, porcelain and many other materials to themselves or each other, according to a release from Devcon Corp.

Form Sun-Olin Firm

Sun Oil Co., Philadelphia, Penna., and the Olin Mathieson Chemical Corp., Baltimore, Md., have agreed to form a joint affiliate, to be known as Sun-Olin, for the manufacture of urea. The two firms have each put up $2 million as initial capital and the remaining funds for the project will be obtained through bank loans, current reports state. To make use of surplus capacity for manufacturing ammonia, a plant will be erected at North Claymont, Del., adjacent to a large Sun Oil refinery at Marcus Hook, Penna., where the ammonia to be used to make the urea will be turned out as a by-product.

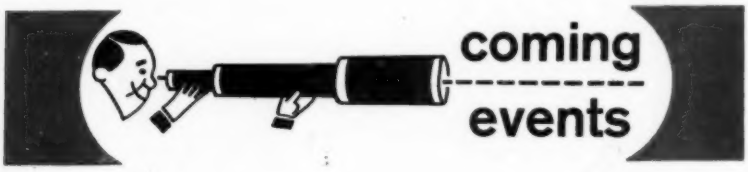
Construction is expected to begin shortly and production, at the rate of 200 tons a year, is expected to begin in January, 1960. Carbon dioxide, to be mixed with the ammonia to make the urea, will come from natural gas supplied by Sun Oil. Sun-Olin will sell a hydrogen by-product back to Sun Oil. Since the Sun Oil and Sun-Olin plants will be next to each other, the ammonia and gases will be delivered through connecting pipes. For years, urea has been employed as a fertilizer and a supplementary food for cattle. A big market also exists in the industrial chemical field, where it is used for making formaldehyde resins, bonding adhesives, dye pigments and pharmaceuticals, and to treat many different kinds of textiles and paper.

Opens New Laboratory

Air Reduction Chemical Co., a division of Air Reduction Co., New York, N.Y., has opened a new chemical laboratory and engineering office building at Bound Brook, N.J. The new $400,000 installation is an expansion of the company's existing development facilities at Bound Brook. The company reports that the new building will be the center for the development of chemical processes and products, and for research on product applications.

New Polymer Laboratory

UBS Chemical Corp., Cambridge, Mass., has broken ground for the construction of its new polymer development laboratory and pilot plant at Marlboro, Mass. The company's main production facilities are in Cambridge, where it manufactures industrial adhesives, polymer emulsions, coatings, finishes, fabric backings and a great many other specialty items.



May 6-8. 36th Annual Meeting of the American Institute of Chemists, Hotel Traymore, Atlantic City, N.J.

May 6-8. Electronic Materials Conference, Benjamin Franklin Hotel, Philadelphia, Penna.

May 17-21. 61st Annual Meeting of the American Ceramic Society, Palmer House, Chicago, Ill.

May 25-27. 10th TAPPI Coating Conference, Statler Hotel, Boston, Mass.

May 25-27. 42nd Annual Conference of The Chemical Institute of Canada, Halifax, Nova Scotia.

May 25-28. Design Engineering Show, Convention Hall, Philadelphia, Penna.

May 25-28. Office Machinery & Equipment Exposition, Municipal Auditorium, New Orleans, La.

June 9-12. Material Handling Institute Exposition, Public Auditorium, Cleveland, Ohio.

June 14-17. Annual Convention of American Leather Chemists Association, Grand Hotel, Mackinac Island, Mich.

June 15-19. Annual Meeting of the American Society for Engineering Education, Pittsburgh, Penna.

June 19-20. National Hide Association, French Lick-Sheraton Hotel, French Lick, Ind.

June 21-26. American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 22-27. Railways Supply Mfrs. Association, Convention Hall, Atlantic City, N.J.

July 1-19. Chicago International Fair Exposition, Navy Pier, Chicago, Ill.

July 6-10. Gordon Research Conference, Polymers, Colby Junior College, New London, N.H.

Aug. 18-21. 10th TAPPI Testing Conference, Multnomah Hotel, Portland, Ore.

Aug. 31-Sept. 4. Gordon Research Conference, Chemistry of Adhesion, New Hampton School, New Hampton, N.H.

Sept. 10-11. ASME Wood Industries Conference, Multnomah Hotel, Portland, Ore.

Sept. 21-25. 14th Annual Instrument-Automation Conference and Exhibit, International Amphitheatre, Chicago, Ill.

Sept. 21-25. International CIB Congress of 1959, Rotterdam, The Netherlands.

Sept. 27-30. American Institute of Chemical Engineers, St. Paul, Minn.

Sept. 28-30. American Oil Chemists' Society, Hotel Statler, Los Angeles, Calif.

Oct. 7. Society of Plastics Engineers, Cleveland Section, Cleveland, Ohio

Oct. 18-22. The Electrochemical Society, Inc. Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 20-24. 24th Paint Industries' Show, Convention Hall, Atlantic City, N.J.

Jan. 12-15, 1960. 16th Annual Technical Conference, Society of Plastics Engineers, Conrad Hilton Hotel, Chicago, Ill.

Jan. 26-27, 1960. Society of Vacuum Coaters, Technical Conference, New York, N.Y.

Feb. 2-4, 1960. 15th SPI Reinforced Plastics Division Conference, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago, Ill.

Amory Smith

Avery Names Manager

Avery Label Co., Monrovia, Calif. has appointed Amory Smith regional sales manager of its newly-opened sales office at Atlanta, Ga. Mr. Smith, formerly district manager of Avery's Chicago office, will make his headquarters at 1038 West Peachtree St., N.E., Atlanta 9, Ga. The company also announced the appointments of Henry Evjen as sales representative in western Tennessee and northern Mississippi; John Cottrell to cover eastern Tennessee; D. B. McLay to cover northern Alabama; and Ken Miller to handle sales in Florida.

Glue To Restore Ship

Cascophen, a waterproof resorcinol glue, developed by Borden Chemical Co., will be used in the restoration of the U. S. Frigate *Constellation*, the world's oldest ship still afloat. One hundred gallons of Cascophen have been donated by Borden to the Constellation Restoration Program. They will be used to restore the exterior hull planking and will hold the planks to the 12 x 12 frames of the ship. Two days older than the Navy Department, the *Constellation* served in every war since 1798. A commissioned ship for 155 years, it was the Flag Ship of the Atlantic Fleet during World War II.

Ciba Offers Nomograph

Structural Resins Department, Ciba Products Corp., Kimberton, Penna., is offering, without cost or obligation, an Araldite Epoxy Resin/Hardener Nomograph. According to the company, the Nomograph will aid in the determination of epoxy resin/hardener ratios.

TAPPI Plans 10th Annual Coating Conference on May 25-27

The 10th Annual Coating Conference of the Technical Association of the Pulp and Paper Industry will be held at the Statler-Hilton Hotel, Boston, Mass., on May 25-27. The program for the technical sessions is:

First Technical Session—"Progress Report No. 2—TAPPI Project 600," by J. V. Robinson (Mead Corp.), and "The Interpretation of Statistical Data Obtained in the Coating Process," by Robert C. Chase (University of Maine).

Second Technical Session—"The Kohler Coating Method," by J. R. Gunning (Provincial Paper Ltd.) and John B. Kohler (Consulting Engineer); "The Comparison of the Air Doctor and Blade Coater," by George Booth (Black-Clawson); "New Coating Preparation at Blandin Paper Company," by C. A. Richardson (Blandin); "The Optical Efficiency of Titanium Dioxide Pigments in Paper Coating," by F. R. Marchetti and W. R. Willets (Titanium Pigments); and "Modification of Coating Color Flow Properties with Amines," by Wade Claxton (Minerals & Chemicals).

Panel Symposium on Coatings: Past, Present and Future—"Coatings Past," by N. I. Bearse (Oxford-Champion); "Board Coating," by W. H. Aiken (Diamond-Gardner); "Coatings Present," by Harold Annis (Oxford Paper); and "Coatings Future," by Paul Thoma (Time).

Third Technical Session—"The Effect of Styrene-Butadiene Ratio on the Properties of Clay Coated Papers," by H. C. Carlson (Koppers); "Study of the Water Retention of Latex Bound Clay Coating Colors," by C. W. Cairns (Dow Chemical); "Microparticle Size Vinyl Acetate Copolymer Emulsion as Economical, Low Odor Clay Coating Binder," by N. Tompkins (Dewey & Almy); "High Amylose Corn Starch—Properties and Prospects," by F. R. Senti (U.S. Department of Agriculture); and "Cationic Starches as Paper Coating Binders," by D. S. Grief (National Starch).

Fourth Technical Session—"Experience with Control Charts on Ink-Film Thickness and Sharpness," by W. L. Rhodes and J. Petrycki (Rochester Institute of Technology); "Penetration Controlling (or water retention) Properties of Colloid Additives," by A. Miller (Kelco); and "Rheological Properties of Suspensions and Polymeric Solution," by A. B. Metzner (University of Delaware).

New Polyester Resins

Hooker Chemical Co., Niagara Falls, N.Y., has developed two polyester resins, Heterofoam 10 and Heterofoam 14, which can be used to make rigid urethane foams. The company reports that the products have excellent adhesion properties as well as permanent high-level fire resistance; high strength; dimensional stability at high temperature and humidity; low thermal conductivity; resistance to water absorption and low moisture permeability; and outstanding permanence.

Adhesives for Wood

242 Pages • Illustrated • $5.00

This book will serve as a guide for the younger technician and provide a ready reference for the experienced man. Considering the age-old problem of the engineer—how to join components together—this book covers the joining of wood-to-wood as well as wood-to-metals and plastics. Truly a must for any adhesives library.

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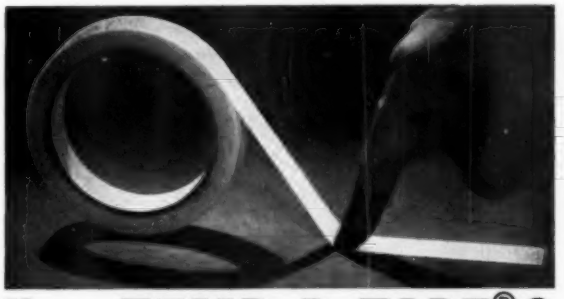


New TEMP-R-TAPE® C

.002" thick, 2750 v/m pressure sensitive TEFLON* tape For -100°F to 500°F applications

TEMP-R-TAPE® C, CHR's newest pressure-sensitive tape, is made of ultra-thin, high dielectric, cast Teflon film to which a silicone polymer adhesive has been applied. Both pressure-sensitive and thermal curing, the adhesive sticks well to any surface over a −100°F to 500°F (−70°C to 260°C) temperature range. Providing an easy-to-apply, extremely thin, high dielectric insulator (2750 volts/mil), TEMP-R-TAPE C was designed for and is now being used in the manufacture of miniature electronic units to withstand Class H and higher temperature requirements. *Send for data on TEMP-R-TAPE C and CHR's other extreme temperature, electrical and mechanical pressure-sensitive tapes.*

CONNECTICUT HARD RUBBER

NEW HAVEN 9 CHR **CONNECTICUT**

names in the news

Samuel G. Baker, head of Organic Chemicals Division at DuPont, has been named "most distinguished alumnus" for 1959 by the University of Washington.

Hsueh-Ting Lee has joined the Plastics and Adhesives Research Section at Picatinny Arsenal, Dover, N.J., as research chemist.

James W. Swaine has been elected to the post of vice-president of General Chemical Division, Allied Chemical Corp.

William J. Kelly has been named technical representative for the Industrial Products Department of Canadian Resins & Chemicals Ltd.

Robert S. Lambert, Jr., formerly with Dresser Industries, has been appointed manager of manufacturing for Air Accessories, Inc.

Donald J. Giroux has been appointed general manager of H. B. Fuller Co. (Canada) Ltd., a newly formed subsidiary of H. B. Fuller Co.

Col. Gregory "Pappy" Boyington, formerly aircraft products manager, has been appointed vice-president, public relations by Coast Pro-Seal & Mfg. Co.

Duncan Douglass, formerly general manager of B. F. Goodrich Chemical (Canada), has been named operations manager for sales services of B. F. Goodrich Canada. **J. C. Pavanel** has been named sales manager at B. F. Goodrich Chemical (Canada).

Donald B. Tuson has been named to the newly created post of vice-president, finance, of Reichhold Chemicals, Inc.

Robert W. Wert has been named field representative for chemical distributor operations for the Minerals & Chemicals Corp. of America.

John Klassen, formerly research supervisor, has been named technical superintendent at the Sarnia, Ont., linear polyethylene plant of Du Pont of Canada.

Bernie G. Edstrom

Joins Palmerton Staff

Bernie G. Edstrom has been appointed advertising sales representative for Palmerton Publishing Co., Inc., New York, N.Y. Mr. Edstrom, who will have his headquarters at 2169 Eldred Avenue, Cleveland 7, Ohio, phone Lakewood 1-7900, will cover Ohio, Michigan, Western Pennsylvania and Western New York. A native of the Cleveland area, he has been engaged for several years as a publication representative, calling on manufacturers and agencies for various journals. He will represent all three Palmerton publications: ADHESIVES AGE, *Rubber Age and Rubber Red Book.*

Hooker Appoints Four

Eastern Chemical Division of the Hooker Chemical Corp., Niagara Falls, N.Y., has named John S. Coey, a corporate vice-president in charge of eastern chemical sales, sales manager of the Eastern Chemical Division. Robert F. Schultz, formerly works manager of the Niagara plant has been named production manager of the division; A. Richard Perry, formerly assistant comptroller, has been named division comptroller; and Philip D. Bosso, who was personnel director at the Niagara plant, has been appointed industrial relations manager of the Eastern Chemical Division.

Portrait Of

Walter C. O'Leary

Mr. O'Leary's special interest for the last six years has been the development and application of high strength adhesives for use in bonding metals and honeycomb structure. A member of the ADHESIVES AGE Editorial Advisory Board, he has been employed by the Minnesota Mining and Manufacturing Company for 12 years.

His responsibilities have included research and development in the field of adhesives and related products. However, he has also held pivotal posts in the 3M Company's laboratory administration and management divisions. At present he is technical director of the company's Adhesives, Coatings and Sealers Division.

Mr. O'Leary received his academic training at Alfred University and New York State College of Ceramics in Alfred, New York. In 1946, he obtained a B.S. degree in chemistry from the University of Detroit. Before coming to Minnesota Mining, he worked for Briggs Mfg., R. P. Scherer Corp., and Plaswood Corp.

A member of various technical and professional associations, Mr. O'Leary has been particularly active in the American Chemical Society. Because of his special knowledge of the subject, at a recent meeting of the Society of Aircraft Materials and Processes Engineers he presented a paper dealing with various factors bearing on the design of honeycomb adhesives.

Born in Utica, New York, Mr. O'Leary is married and the father of five.

Design Engineers To Display Adhesives

The 1959 Design Engineering Show, to run concurrently with the Design Engineering Conference on May 25 to 28 at Convention Hall, Philadelphia, Penna., will feature displays by several adhesives manufacturers. The conference is sponsored by the Machine Design Division of the American Society of Mechanical Engineers in cooperation with the ASME Philadelphia Section.

Industrial Division of the Armstrong Cork Co., Lancaster, Penna., will have displays on adhesives, gaskets, vibration damping felts, friction materials and teflon, cast urethane and asbestos products. In addition to static displays, there will be four dynamic demonstrations. One of these will be an adhesives exhibit, which will demonstrate the effectiveness of the new Eastman 910, distributed by Armstrong, by bonding samples on the spot.

The company will install a special telephone booth with a direct line to its Research and Development Center in Lancaster for handling questions when detailed chemical and physical knowledge is not available at the exhibit booth. Visitors seeking detailed technical information about specific products will be invited to pick up the telephone and speak directly with Armstrong's research man responsible for that product.

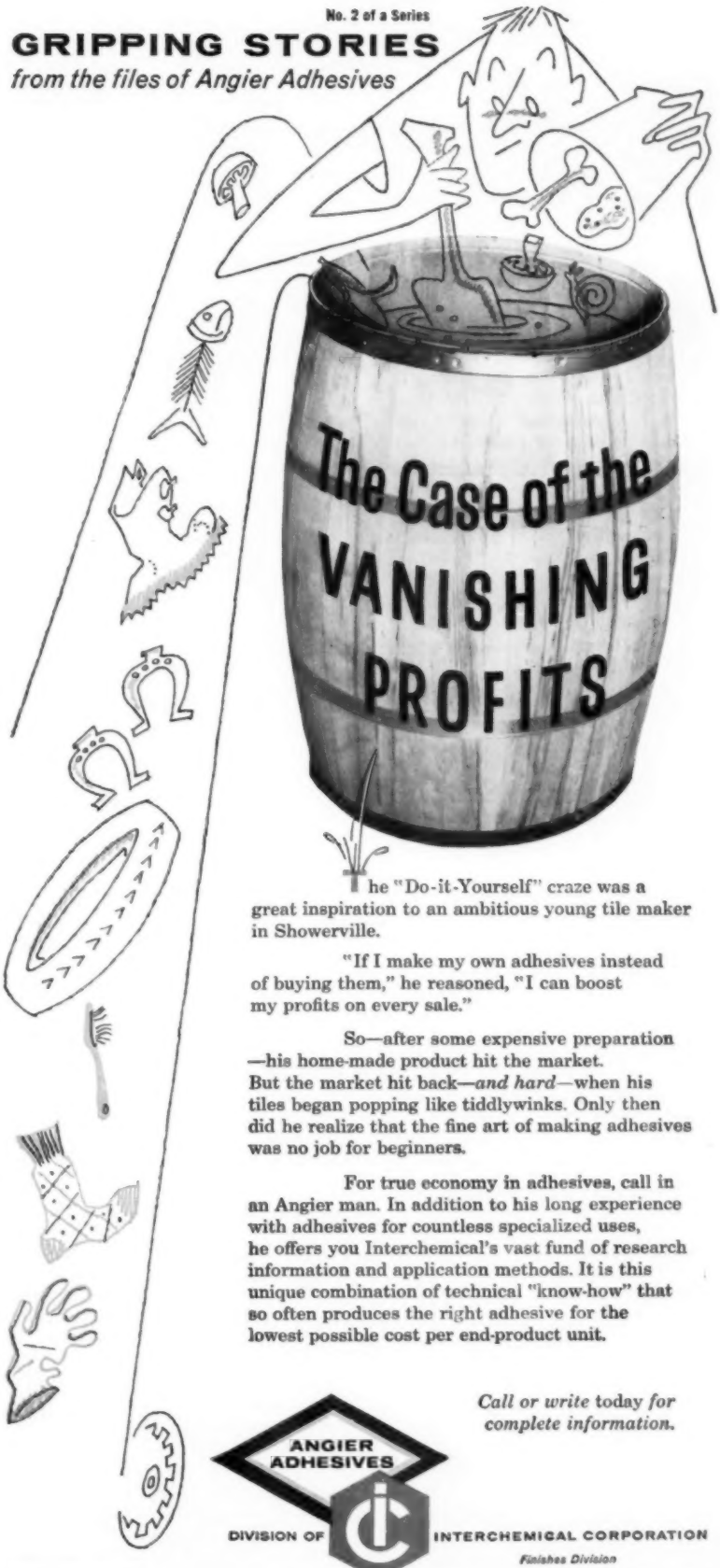
Permacel, New Brunswick, N. J., will feature several new products at its display. Exhibits will include Permacel Ribbon Dope Thread Sealant, several new epoxy resin systems, electrical tapes and heater element sandwich materials. Permacel Ribbon Dope Thread Sealant is said to be a completely new kind of pipe dope with qualities superior to any other method of pipe joint sealing. Epoxy resin Permacel PRH 400 is a solvent based epoxy system and is recommended for use as a protective coating for printed circuits and other electrical and electronic components. PRH 401 is a single component system, recommended for use in adhesive for metals; impregnating of coils; manufacture of stators and rotors; and dry lay-up applications of glass cloth.

New Permacel Electrical Tapes will include Permacel 246 Electrical Grade Rayon Reinforced Film Tape and Permacel 422 Teflon Film Tape, pressure-sensitive. Another product, Permacel PSR 2700 is a new heater element sandwich material recently developed by the company. Also featured will be Permacel ET 3700 Skived Teflon Film.

No. 2 of a Series

GRIPPING STORIES

from the files of Angier Adhesives



The "Do-it-Yourself" craze was a great inspiration to an ambitious young tile maker in Showerville.

"If I make my own adhesives instead of buying them," he reasoned, "I can boost my profits on every sale."

So—after some expensive preparation —his home-made product hit the market. But the market hit back—*and hard*—when his tiles began popping like tiddlywinks. Only then did he realize that the fine art of making adhesives was no job for beginners.

For true economy in adhesives, call in an Angier man. In addition to his long experience with adhesives for countless specialized uses, he offers you Interchemical's vast fund of research information and application methods. It is this unique combination of technical "know-how" that so often produces the right adhesive for the lowest possible cost per end-product unit.

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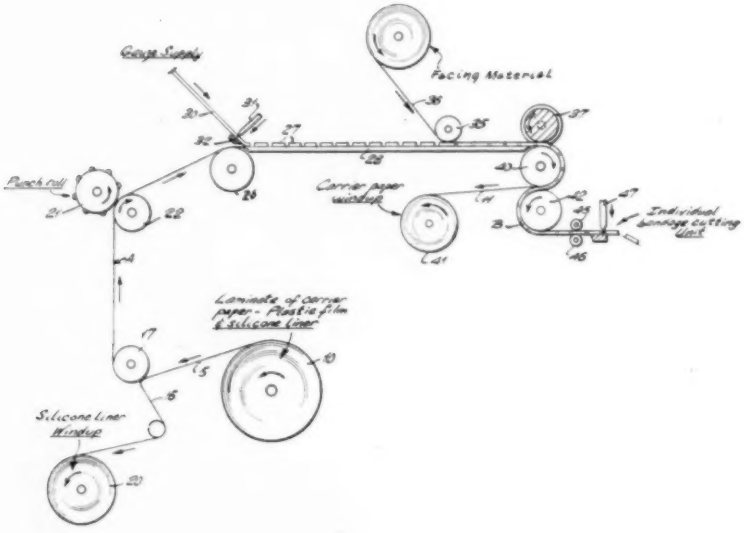
patent review

By MELVIN NORD

Plastic Strip Bandages

U. S. Patent 2,862,846, issued December 2, 1958 to Benjamin B. Blackford and William J. Gross, assigned to Johnson & Johnson, describes a process for producing plastic strip adhesive bandages.



As shown in the schematic diagram, reference number 10 designates a roll of a web or sheet of laminate material (5). The laminate is formed from a layer of paper 0.003 to 0.012-inch thick. Superimposed on the carrier paper, and adhering to it is a layer of plastic film, which may be 0.001 to 0.010-inch thick. The plastic film is formed of a vinyl type plastic such as polyvinyl chloride compounded in known manner with other materials such as plasticizers and stabilizers. It has on its top surface a thin layer of adhesive, which may be a compounded mixture containing the usual rubber base, tackifier and plasticizer. Superimposed on the adhesive layer is a layer of liner paper (16), preferably treated with materials such as a silicone polymer, which serves to prevent sticking of the adhesive layer to other layers of the laminate in the roll (10).

The laminate is withdrawn from the roll, and passed around a guide roll (17), at which point liner paper (16) is withdrawn and wound up on roll 20. The web (5) continues between a punch roll (21) and an anvil roll (22), at which point vent holes are punched through the laminate. It then passes over roll 26, where it picks up gauze pads (27) and meets a supporting table (28). Pads (27) are formed from a continuous strip or multiple of strips of gauze (30), folded and severed by a knife, shown schematically at 31, which co-acts with an anvil (32).

The laminate (5) continues its travel along the table (28) and reaches a roll (35) where two continuous strips of sheet facing material (36) are added, one on each side of the row of gauze pads (27) and overlapping near the center of the laminate. The laminate then passes between plaster pull rolls (37 and 40), which may be suitably knurled to assure positive motion. The upper pull roll (37) has a receded center portion to accommodate the gauze pads placed near the center of the web (5). The endwise protruding portions of the roll surface thereby serve in cooperation with the lower pull roll (40) to press facing strips (36) to a substantial degree into intimate contact with adhesive on either side of the centrally disposed row of gauze pads (27) to form a composite layer.

As the laminate (5) passes around the roll (40), it is formed of a bottom layer of carrier paper, a layer of plastic film having an adhesive surface, a row of gauze pads, and a layer of facing sheet covering and pressed to a substantial degree into the adhesive. After the web rounds the roll, the carrier paper (11) is removed and wound up on roll 41. The laminate is removed from roll 42 by metering rolls (45 and 46), which feed the web at a uniform rate into an individual bandage-cutting unit (47).

Adhesive for Metals

U. S. Patent 2,859,200 issued November 4, 1958 to Risto P. Lappala and assigned to Bjorksten Research Laboratories, Inc., discloses an organic adhesive adapted to adhere metals to one another, and to be applied and cured at room temperatures.

An example of the composition used is the following: 10 grams methacrylic acid inhibitor free; 90 grams methyl methacrylate inhibitor free, and 30 grams polymethyl methacrylate molding granules. These ingredients are heated at about 130°F. and agitated until the polymethyl methacrylate is dissolved.

Laminate Protein Adhesive

U. S. Patent 2,862,896, issued December 2, 1958 to Joseph B. Dede and Donald A. Watson, assigned to Monsanto Chemical Co., describes a process for preparing modified protein adhesives which are suitable for use in laminating wood to itself or other materials.

A dry base for a protein glue is prepared by dry blending 15 parts of casein, 53 parts of soybean flour, and sufficient amounts of conventional additives such as defoaming oils, wood flour, sodium fluoride, sodium carbonate, and hydrated lime to make 100 parts of dry blend. One hundred parts of the dry blend are stirred into 200 parts of water until a smooth paste is formed; the mix is allowed to stand for about 15 minutes, and another 40 parts of water are added with agitation. Stirring is continued for about 15

minutes, and 85 parts of a 50% solids latex of a quadricomponent interpolymer are added. Stirring is then continued until the latex is thoroughly blended with the protein paste.

The quadricomponent interpolymer is an interpolymer containing, for example, (1) an unsaturated ester of alkyl methacrylate, (2) acrylonitrile, (3) methacrylic acid and (4) styrene.

Plywood Adhesive

U. S. Patent 2,862,897, issued December 2, 1958 to Eugene M. Barrentine, Theodore S. Hodgins, and Frederic J. Shelton, assigned to Reichhold Chemicals, Inc., describes a method of preparing an adhesive composition for use in the manufacture of plywood.

In particular, the invention relates to the production of aqueous solutions of phenol-formaldehyde resinous products combined with hydroxyalkylcellulose as a thickening agent.

Dispersible Starch

U. S. Patent 2,865,775, issued December 23, 1958 to James W. Todd, assigned to National Industrial Products Co., describes a process for preparing cold water dispersible starch.

The process consists of mixing starch of which at least 50% is thin boiling, with borax in a quantity of about 34% by weight of the starch on a dry basis, and with sulfuric acid in a quantity of about 6% of the weight of the starch on a dry basis.

Pressure-Sensitive Tape

U. S. Patent 2,862,613, issued December 2, 1958 to Albert J. Klemka and Charles O. Pike, assigned to Norton Co., describes a pressure-sensitive adhesive tape having improved release characteristics.

It has been discovered that when a release agent is incorporated into the backsize of a tape and then the backsize is placed in close proximity to the pressure sensitive adhesive mass of the tape, as by winding the tape into roll form, the adhesive will gradually dissolve or extract the release agent from the backsize and thus reduce the release characteristics of the tape. Attempts to incorporate a sufficient amount of release agent in the mass to produce effective release characteristics in the finished tape have resulted in marked deterioration of the adhesive mass, particularly as to its adhesive characteristics.

However, it has been found that by incorporating in the mass a small amount of the same or a similar release agent as that also incorporated in the backsize, the tendency for the release agent to migrate to the mass is substantially eliminated, the adhesion of the mass is not impaired, and the effective life of the release agent is extended far beyond that possible by any other procedure.

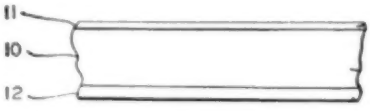


Figure 1

In Figure 1, the numeral 10 represents a tape backing which may be either fibrous or non-fibrous. Applied to one surface of this backing (10) is an adhesive repellant or backsize coating (11) containing release agent. On the opposite side of the backing is a pressure-sensitive adhesive coating (12) containing release agent.

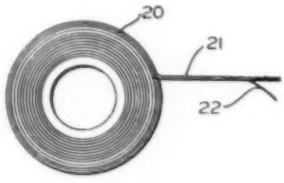


Figure 2

Figure 2 illustrates a roll of double-face adhesive tape (22) having pressure-sensitive adhesive coatings on both surfaces. In accordance with the present invention the pressure-sensitive adhesive coatings each contain release agent. Inter-rolled with the tape is a removable liner (21) having an adhesive repellant coating containing release agent on both sides.

Other Patents of Interest

Subject	Inventor or Assignee	Patent No.	Date
Lint remover and pressure sensitive adhesive tape dispenser	William Berezny	2,854,682	10/ 7 /58
Glue tipping apparatus	Carlisle G. Lea et al.	2,855,892	10/14/58
Pressure sensitive adhesive article containing dextran	The Commonwealth Engineering Co. of Ohio	2,855,925	10/14/58
Adhesivity of bituminous binders	Esso Standard Societe Anonyme Francaise	2,856,308	10/14/58
Foundry sand binder composition	Borden Co.	2,856,381	10/14/58
Production of an adhesive for floor coverings	Philipp Albrecht et al.	2,857,288	10/21/58
Sulfur-curable polyalkyleneether polyurethane adhesive compositions	E. I. du Pont de Nemours & Co.	2,858,287	10/28/58

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

new equipment

Portable Cold Glue Mixer

A portable, motor driven machine for preparing all sorts of cold adhesives, and other materials with similar characteristics, is said to eliminate the hard work and uncertainty of mixing such glues in small quantities by hand. Four sizes

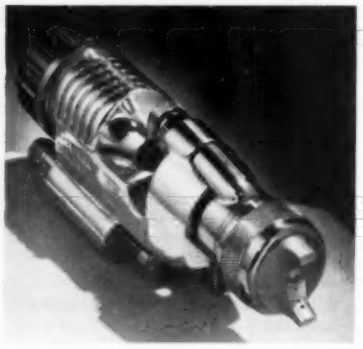
are offered: 2, 5, 7½ and 15 gallons mixing capacity. The base and arm of the machine are of welded steel construction, finished with gray enamel. The ball bearing motor is built especially for vertical operation, and is fitted with a plug and cord for light socket use. Single phase, 60 cycle, 115 volt is standard. The agitator works in the vertical position, the three adjustable revolving paddles being supplemented by three stationary vanes which provide the effect of two-way agitation. The hinged arm may be swung up to allow the pail to be inserted or removed. *Black Brothers, Inc.* **E-73**

Industrial Thermostat

The Dual Microtrol, a high quality, hydraulic bulb type, sensitive thermostat, is recommended for use on water baths, incubators, ovens, sterilizers and related units. A unique design, featuring two individual switch carrier arms and one common sensing element, is said to permit great versatility. The unit may be used to provide a setting of two preselected temperatures for quick duplication; as a safety control; and for programming at low cost. Response sensitivity of ±1°F. is claimed to actuate the control. The unit is completely enclosed in an enameled steel case, 2¼-inch wide by 4⅜-inch deep by 4¾-inch high, ready for panel or external mounting. Two temperature ranges, 50°F. to 220°F., and 100°F. to 550°F., are available for 115 or 230 volts. *Blue M Electric Co.* **E-74**

Automatic Spray Gun

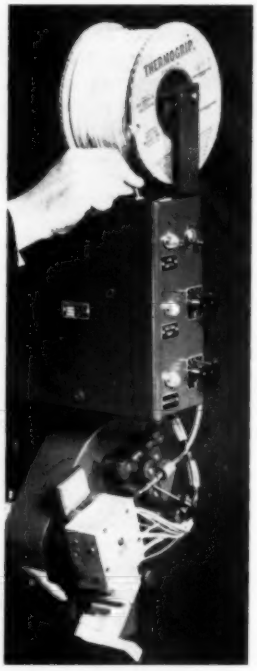
An automatic spray gun, designated Type AGA, is built for mass production spray application of liquids, including adhesives, to articles being produced on automatic or semi-automatic machines. Various nozzle combinations are said to pro-



vide complete interchangeability for the type liquid or adhesive being sprayed. The unit is air operated, and is said to offer split second starting and stopping. The spray pattern is manipulated by a pattern adjusting nut. The removable spray head, with the wide range of nozzle combinations, is designed to allow for quick conversion to utilize changes in materials. The unit is 7 x 2¼ x 2¾-inches in size, and is said to be easily installed in close quarters and in compact groupings of several guns. The mounting stud and various clamping fixtures provide complete flexibility. The design of the gun, featuring a fast acting piston with positive mechanical linkage, is said to offer split second starting and stopping. Net weight of the unit is 2¾ pounds, and shipping weight is 4 pounds. *DeVilbiss Co.* **E-75**

Hot Melt Adhesive Applicator

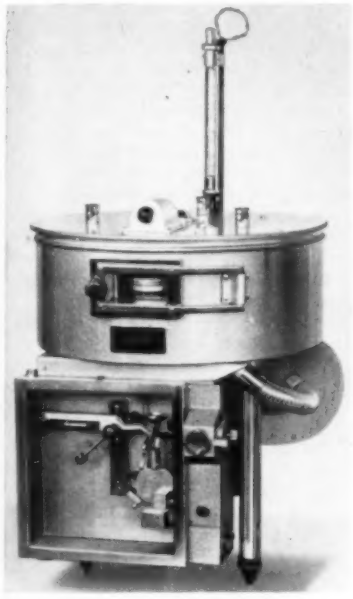
A new hot melt adhesive applicator, designed for installation on parent machines processing continuous webs of material, feeds, melts, and applies cord-like adhesives through a nozzle. The mechanical drive for the unit, which is designated Thermogrip Applicator, Model CN, is taken from the base machine



and in a ratio that maintains adhesive output proportionate to material speed. Adhesives may be applied up or down onto the moving materials, and in one or more bands. Thickness can be controlled. Uniformity and control without waste are said to be permitted by the thermostatically operated heating units located in the melting and applying parts. Heat controls are readily adjustable to provide optimum adhesive performance with various materials and adhesive formulas. Clean-out of adhesive pots and rolls is eliminated by use of the cord-like adhesive. The applying parts of the applicator may be assembled in different ways, and modified or adjusted to permit installation of the gluer on a wide variety of equipment. *United Shoe Machinery Corp.* **E-76**

Moisture/Volatiles Tester

A new tester is said to make the measuring of moisture or volatiles in materials a simple and fast operation which unskilled personnel can perform with an accuracy of ± 0.05%. Its semi-automatic operation eliminates the need for double



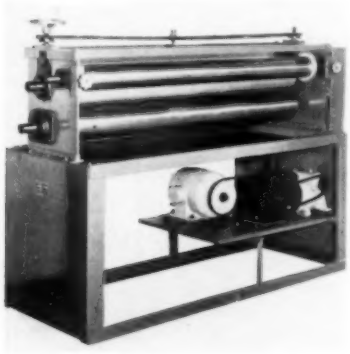
weighing, desiccator cooling and calculating. Exclusive updraft baffle heat and magnetic damping features are claimed to be instrumental in increasing the testing speed and accuracy. Ten gram samples are weighed in special pans and, after any given drying periods, moisture loss percentages may be read directly from the scale. The tester has ten sample trays, so that a series of samples from various parts of a batch may be recorded for averaging purposes. *C. W. Brabender Instruments Co.* **E-77**

Solvent Recovery Unit

A small, packaged solvent recovery unit comes in two forms, a single unit model and a double unit model. Dimensions of the former are 50 x 41 x 81 inches, and of the latter 74½ x 41 x 81 inches. The unit, which is suitable for use with any process in which a water-immiscible solvent is lost by vaporization, features heavy gauge construction with all metal specially treated for corrosion resistance. Activated carbon, selected to provide maximum recovery of solvent vapors and years of service life, is used as the basis of the recovery operation. The unit is said to also pick up practically all of the solvent odors in the working areas. *Vic Manufacturing Co.* **E-78**

Heavy-Duty Glue Spreaders

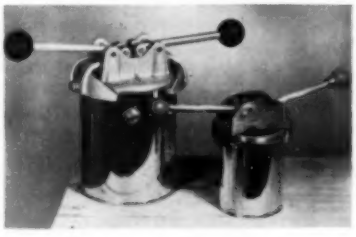
A series of heavy-duty glue spreaders and roller coaters features units equipped with 6-inch rolls and 1½-inch shafts. The machines are available in four types: single top



coater, single botton coater, and two models for coating one or both sides. New feeder and take-off conveyors are also available from the manufacturer. The model illustrated is the heaviest of the line. *L. R. Wallace & Co.* **E-79**

Can Closing Tool

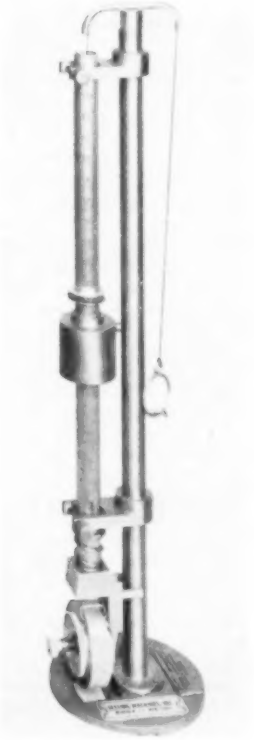
A hand-operated closing tool for friction top containers is available for quart can and gallon pail sizes. Use of the tool is said to make sealing from 10 to 12 times faster than hand



sealing. The tool is light but rugged and durable, and is designed so as not to damage containers. It also allows easier and tighter resealing of containers. Operation is said to be very simple, with no special instruction necessary. *Gardner Laboratory, Inc.* **E-80**

Portable Tackmeter

A commercially available instrument for assessing surface tack numerically has been announced. Called the Dunlop Tackmeter, it was originally developed for the measurement of tack of rubber or rubber



products, though it is useful in other industries where surface tack is an important technological property. The instrument can be modified to suit less or more tacky surfaces. The unit is hand-operated, and easily portable. It assesses the tackiness of a surface from measurements which are normally carried out at ten chosen points of the material surface. It does no damage to the surface under examination. The principle of the Tackmeter is said to result in a close reproduction of conditions apt to be experienced in practice. *Testing Machines, Inc.* **E-81**

FOR MORE INFORMATION on the new equipment items described here, use the Reader's Service Card elsewhere in this issue.

book reviews

Polymers and Resins: Their Chemistry and Chemical Engineering. ***By Brage Golding. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 6 x 9¼ in. 744 pp. $15.00.***

The author of this book, after searching for an up-to-date text which presented theory, chemistry, properties, manufacture, fabrication and applications of polymeric and resinous materials and being unable to find it, decided to write one. The end product, he says, is twice the size originally intended because there was so much to cover in all these fields, despite the fact that only products of commercial significance were included for discussion. Though he may be surprised at the size of this thick volume, he can certainly take comfort in the knowledge that he has not permitted quality to suffer for quantity. He has produced a valuable, well-written and highly technical text for the advanced and graduate student of the chemistry and chemical engineering of organic, polymeric and resinous substances, and a book which will serve for some time as a reference to these rapidly expanding fields.

A listing of the chapter titles indicates the broad scope of the treatment: (1) Introductory Concepts and Definitions; (2) Functionality and Polymer Formation; (3) Mechanical and Chemical Behavior; (4) Characterization of Polymers; (5) Methods of Polymerization; (6) Technology of Manufacture: Natural Products; (7) Technology of Manufacture: Modified Natural Products.

And (8) Technology of Manufacture: Synthetic Condensation Products; (9) Technology of Manufacture: Synthetic Addition Products; (10) Effect of Molecular Structure upon Mechanical Behavior; (11) Fabricating and Processing, and (12) Applications. Subject and names indexes close the volume. A list of literature references follows each chapter.

As would be expected, adhesives are mentioned numerous times throughout the book, and in the chapter on "Applications" a 10-page survey of adhesives is made. This part opens with definitions of the term "adhesion", both in non-technical and technical terms, and continues with an explanation of the distinction between "specific" adhesion and "mechanical" adhesion. It also offers other similar basic information, and then launches into detailed presentations of the various adhesives—starch-based, those from natural gums, animal glue, thermoplastic and thermosetting synthetic resin, cellulose nitrate, urea resin, melamine-formaldehyde resin, resorcinol-formaldehyde, furan resin, unsaturated polyester resin and others. In connection with these, various commercial applications, the bonding of different materials, and similar subjects are also discussed. Included in this part are two tables, one classifying adhesives according to the method of obtaining flow and solidification, and the other according to the base of the composition.

The other references, made in connection with specific materials, such as butyl rubber, or in connection with certain applications, as the bonding of rubber to steel, are easily locatable by the use of the subject index. The author has produced an excellent and timely volume with extensive coverage of the incredibly complex, expanding and important fields of polymers and resins. The information included will benefit not only the student, but the practicing engineer and chemist.

Engineering Materials Handbook. ***Charles L. Mantell, Editor. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. Approximately 2000 pp. $21.50.***

The authors of this book total over 150 specialists in various fields. The purpose of the volume is to supply the practicing engineer, designer, student or purchasing agent with an authoritative reference work on engineering materials. The volume opens with a list of abbreviations and chapters on properties of materials and processing techniques. It then continues with 39 additional chapters on various materials, and closes with two chapters on materials problems of specific industries and sources of information. An extensive subject index follows the text.

One of the chapters is devoted to "Gaskets, Packings, Adhesives and Cements." About 15 pages are given to the latter two. The part on adhesives, authored by Roger K. Humke, is a short encyclopedic presentation of adhesives materials. It opens with a definition, and a table listing the advantages and limitations of adhesive fastening, and another which gives a classification of adhesives by method of setting to form the bond. Discussions of raw materials and end uses are included. Other tables are devoted to classification of adhesives by chemical type of basic ingredient, and characteristics of rubber adhesives. Extensive tables, covering several pages each, are devoted to adhesives, their types, resistances and effectiveness; and to a reference chart for bonding different materials. A list of literature references closes the section.

The part on cements, which covers approximately three pages, was authored by C. R. Payne. In the main it is devoted to the chemical resistance of the six general types of cement used in chemical construction to resist the attack of acids, alkalies, corrosive salt solutions, solvents and other corrosive chemicals. Information on chemical properties of the cements and manufacturing data are presented in tabular form. A brief discussion in text is devoted to each of the six types—furan, phenol formaldehyde, epoxy, polyester, sodium silicate and sulfur.

In addition to the sections specifically dealing with adhesives, there are a number of other references in other sections of the book to bonding materials. These are easily located by use of the subject index, which is very detailed. A bibliography of books on the subject of adhesives, in addition to the literature references already noted, appears in a section at the end of the book devoted to literature. The reader will find a wealth of data in this publication, much of which relates to his needs in a direct way even though not within the chapter on adhesives and related materials.

Trade Literature

Gluing Guide. A 16-page guide to gluing for the layman covers all-purpose adhesives, contact cements, waterproof glues, plastic resin glues and casein glues, outlining uses for each and explaining how they should be applied. A 2-page chart summarizes the information, listing various gluing jobs, requirements of the adhesives to be used and recommendations for specific glues. The booklet, which also contains several additional sections, lists many unusual uses for adhesives in the home. *Borden Co.* **L-81**

Applying Formica. Tools, tips and techniques necessary for working with Formica laminates are covered in this 12-page photo-illustrated booklet for carpenters and contractors. A special section is devoted to the selection and application of contact cements. Details are given on how new or existing surfaces are best prepared for application of the adhesive. Simple techniques are offered for fitting and trimming the Formica and for making window and light switch cutouts. *Formica Corp.* **L-82**

Trade Literature

Epoxy Resin Adhesive. Engineering data on high strength epoxy resin adhesives for metal-to-metal bonding and honeycomb sandwich construction are given in this 11-page technical publication. The properties and performance data of room temperature curing type adhesives EC-1294, EC-1472, EC-1474 and elevated temperature curing types EC-1386 and EC-1469 are discussed and their industrial potential pointed out. Comparative performance data of the above adhesives and other high strength adhesives are given in detail. The booklet also contains information on product application and curing procedures. *Minnesota Mining and Manufacturing Co.* **L-83**

Pneumatic Conveying Systems. Positive pressure pneumatic conveying systems which can be adapted for use in adhesive manufacturing are outlined in this four-page technical bulletin. A special series of schematic drawings illustrates the various diverter valve types which are available. In addition, detailed descriptions are given of system components such as the blow-through airlock feeder, the airlock-manifold combination, the collector, and the conveyor piping to storage bins and processes. The horsepower and line size required for systems ranging in capacity from 1000 to 60,000 lbs./hr. can be easily determined from a chart included. *Sprout-Waldron & Co.* **L-84**

Molding Material. Complete information on Chem-o-sol, an industrial coating and molding material, is given in this 12-page booklet. The properties of this high molecular weight, polyvinyl dispersion are listed and the method by which the material is converted from a liquid to a solid form is explained with the help of charts and photos. Details are given on various application methods such as dipping, casting, low pressure forming, wiping, spraying and spreader coating. A three-page foldout chart gives the uses and properties of different compounds available. *Chemical Products Corp.* **L-85**

Corrugated Board. Charts, tables, specifications, and performance data included in this four-page report are meant as aids in determining the proper grade of board necessary for a particular shipping operation. The results of actual in-use tests are cited, and graphs based on standard Olsen compression tests compare the company product with regular board under different moisture and humidity conditions. *Hinde & Dauch, Division of West Virginia Pulp and Paper Co.* **L-86**

Concrete Bonding. A liquid polymer which cures to a resilient rubber at room temperature when an accelerator is added and which is used for concrete-to-concrete bonding is described in an illustrated 8-page bulletin. Tables present comparative data on compression shear strength compared with other bonding materials, and on flexural strength for new-to-old concrete bonding and old-to-old concrete bonding. Similar information for tensile strength before and after immersion in water is also provided. Text explains advantages of the product and application procedures. *Thiokol Chemical Corp.* **L-87**

Glue Pots. This 16-page catalog contains prices and specifications on a complete line of glue pots and cans for shipping, storage and bench use. Information is also given on various types of cardboard shipping cartons, mailing accessories, and both pail sealing and opening tools. Package types available include: nozzle-tops, cap-spout combinations, caps with riveted brushes, wood-jacketed trade cans, screw tops, flanged tops, and rounded cornered rectangular cans with tear strips and keys. *Freund Can Co.* **L-88**

Aerosol Packaged Adhesive. A photo-illustrated folder is on business and industrial uses of Quik-Stick, a spray-on adhesive. The product sets into a film which can be picked up and moved or replaced like a pressure-sensitive tape. Suggested applications include paint masking; attaching operating instructions and notes on machines; labeling crates, cartons and boxes; mounting photographs, and bonding leather, fabrics and plastics to smooth surfaces. *Hudson Photographic Industries, Inc.* **L-89**

Release Papers. Samples and technical data on the complete line of Ripco release papers are contained in this handsome brochure. Product information sheets point up the availability of these silicone and quilon treated papers in various grades and in a wide range of basis weights. Suggested uses include backing for pressure-sensitive tapes and labels. *Rhinelander Paper Co.* **L-90**

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Stamford Rubber Supply Co.	6
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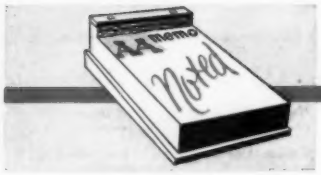

in passing

Rigid Research

We doubt that there are any statistics available to indicate how many adhesive formulations must be prepared and tested before the proper formulation for a specific application—particularly a new application—is determined. We know of some cases where hundreds and thousands of formulations were devised and rejected before a successful adhesive was determined. An idea of the painstaking research which is often required before success is achieved may be secured from the work of a group of scientists at the University of California who have finally obtained a ghostly picture of the atomic particle called the Xi zero. The presence of this particle, which weighs about 2570 times as much as an electron, has been suspected for some time, but because it has zero electrical charge it left no track to be photographed in experiments in which known atomic particles were traced as they plunged through a tank of liquid hydrogen. It took 70,000 photographs to catch one Xi zero in motion. We would call that rigid research.

Hue, Hue

Remember when you last purchased a gift pair of stockings for your wife, daughter or girl friend? Once you knew the size and length, the rest was easy. You ordered pink or green or grey or black. It isn't that easy any more. A recent advertisement for Christian Dior Stockings listed twenty separate shades, among them: Fountain Spray (grapefruit green), Left Bank (blue turquois), Can Can (soft blush tangerine), Spring Violet (light violet), Toast of Paris (medium brown), Scottish Taupe (mauve taupe), and Latin Spice (soft spice). Of course, we have a few terms among some of the newer adhesives, especially those for the household market, which come fairly close. There's a lesson in this, somewhere.

Stretching the Mind

An advertisement by the publishers of "Great Books of the Western World" recently caught our eye. It was headed: "How long has it been since your mind was stretched by a new idea?" The advertisement went on to quote a statement once made by Oliver Wendell Holmes: "A man's mind stretched by a new idea can never go back to its original dimensions." For example, a child who suddenly realizes that the letters in the alphabet are not just isolated sounds and shapes, but meaningful symbols that form words, has grasped an idea that will lead to a continuing expansion of his mind. There comes a time, though, in the lives of too many of us when our minds become occupied only with knowledge we have already learned. When that happens, our minds cease to grow. As we become more and more absorbed with our specialty—whether it is adhesives, law, engineering, or science—we almost cease to absorb the new knowledge that leads to new concepts. It is a horrifying thought, but then most realism is. Have you read any good books lately?

Markets—and Marketing

Many people come up with interesting, practical and useful ideas—but these ideas die aborning because they do not have the means or facilities of transmitting them to the proper sources. A solution to this problem is offered by the Idea Marketing Institute of Upper Darby, Penna. The Institute, which is said to operate equally and alike for the good and welfare of the public, all industry and our national economy, has adopted the slogan: Don't sit on it—sell it! Described as a public service enterprise, IMI is reported to have been founded to (1) Assure you protection of and the promptest possible sale of your ideas of value at a full and fair price; (2) Make available to industry on a fair purchase basis ideas that otherwise never come to the attention of its directorates; (3) Benefit our national economy by accelerating improvement, advancement, new products and new business toward constant betterment of our way of life and increase of the public purchasing power. These are high-minded objectives. Ideas, anyone?

Turnover Toll

The American Management Association recently came up with some startling figures relative to turnover of personnel, which most of us take for granted. The figures: $800 to recruit, process orient and train a highly skilled secretary; $400 for a journeyman machinist; $800 to $1500 for a good salesman; $10,000 for a highly trained scientist or engineer. These are average figures based on turnover costs furnished by controllers of nine prominent companies. Anyone inclined to doubt the dollar value of effective supervisory policies and practices that reduce turnover should think real hard about these figures.